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"THE BLUE RIBBON."

The annual dinner of the Institute last week was a much larger affair than expected and far larger than anything of the kind heretofore carried out under Institute auspices. A dinner to which nearly 500 people sat down, and with over 100 more as spectators is in itself quite a notable affair, but when it celebrates a particular anniversary and is attended by features of unique interest, it becomes memorable. The fact that the dinner signalized the twenty-fifth anniversary of the incandescent lamp and the founding of the first electrical medal of award in this country would in itself be enough to make it stand out conspicuously. It is, therefore, a matter of general congratulation that, according to universal testimony, the dinner was a success in proportion to its magnitude and significance. Those who saw the banquet hall of the Waldorf-Astoria certainly looked upon a remarkably brilliant spectacle, to which the presence of so many ladies contributed in no small measure.

The exercises of the occasion were also worthy of it, and the speeches full of excellent matter, which while not all of the light touch-and-go nature that makes for the laughter or cheering of the moment, stands better the test of time as an expression and record of the feeling of the hour. Mr. Insull, in turning over the Edison Medal and Deed of Gift to the Institute, struck a happy keynote when he characterized the medal as a "blue ribbon" of the profession that every young electrical engineer should be glad and proud to win. We believe the medal will not only help the young men, but will benefit the Institute in bringing it in even closer touch than now with the great body of coming members of the profession. The Edison Medal Association is, finally, to be congratulated on the ease and celerity with which it raised the proposed $7,000, a sum larger than that deemed necessary for the John Fritz Medal and adequate after all preliminary expenses have been met, for all the purposes embraced in its foundation.

THE BALTIMORE FIRE.

We are able to present in our pages this week some interesting data in regard to the Baltimore fire and its effect on the electrical services in that city. On the whole, it is a matter of congratulation that the telegraph and telephone services suffered so little and that such slight damage was inflicted on the lighting and street railway plants. It might have been a great deal worse, especially in view of the wholesale destruction of property, and this naturally brings us to a consideration of the lack of water supply and fire-fighting facilities in general. All reports from Baltimore go to show that the firemen did not have an adequate supply of water at any time. And yet an inexhaustible supply was at hand—"water everywhere, but not a drop to drink." If the firemen had only been able to avail themselves of the salt water all around the burning district they could doubtless have saved enough property to pay for the pumping plant many times over.

The same elements occur in considering the problem of fire extinction in New York City, and we are glad to note that Mayor McClellan has revived the plan to equip Manhattan Island, or at least its more valuable business sections, with salt water mains for fire purposes. These could be readily associated with electric motors for pumping the supply, and the project, if worked out on broad,

adequate lines, should pay for itself several times over in higher insurance and lower rates for the districts covered.

In this connection we wish to emphasize what we have said before and is now our solemn duty to say again. The fire alarm system of New York is sadly and seriously behind the times. It is grossly inadequate. It needs practically entire renovation and reconstruction and the work cannot be taken in hand too soon. If Mayor McClellan will only secure a report from competent, disinterested experts he will find our statements justified and will realize that, with salt water mains or without, he cannot too soon overhaul the fire alarm system itself of this great western metropolis with all its incalculable wealth to be protected.

The Theory of Aluminum Electrolytic Rectifier.

Within the last few years much interest has been displayed in the aluminum-carbon electrolytic cell, since experiments have been made looking towards making the apparatus industrially available as a rectifier. It is known that when a plate of aluminum is opposed to a plate of carbon in a suitable electrolyte, the cell so formed offers but little obstruction to an electric current entering at the carbon and leaving at the aluminum; that is to say, when the aluminum is the cathode. On the contrary, when the current is reversed and the aluminum is made the anode, the cell offers a very marked obstruction and practically shuts off the current, if the voltage does not exceed 20 or more volts. Consequently, when such a cell, or a battery of such cells, is inserted in the path of an alternating current, the semi-waves directed towards the aluminum go through with but little drop of pressure, or waste of power, while the intervening and oppositely directed semi-waves are automatically shut off, to a greater or less extent. In other words, the alternating current has become converted into what is substantially a unidirectional pulsating current. Such an arrangement could, of course, only utilize half the alternating-current impulses. But by the use of divided circuits or branches, with a pair of such batteries, all positive waves could be utilized unidirectionally in one branch, and all negative waves unidirectionally in the other, the two could coact, in most cases, to produce a unitary result, equivalent to complete rectification of the alternating current. The apparatus, however, has not yet come into practical use, mainly owing to relatively large losses of energy in the electric valves. That is to say, the current is not instantly shut off, as soon as the aluminum turns anode, but a certain amount has to go through, in order to shut off the rest, like the "wire-drawing" in an imperfectly adjusted steam valve. If this wire-drawing loss of power could be eliminated, the cell might be capable of some practical service on alternating-current circuits.

In the last number of the *Physical Review*, Mr. S. R. Cook contributes an article of some experiments made to elucidate the action of the aluminum rectifier. There is already quite a literature upon the subject, and various rival theories. The theories differ both as to the nature of the chemical action and also as to the nature of the electrical action. With reference to the electrical action, some contend that the opposition to the electric current, or the electric barrier, of the cell, is wholly, or substantially, a matter of ohmic resistance. They say that when aluminum is made the anode, the anions, either primary or secondary, are hydroxyl ions, which form an oxide or a hydrate film on the aluminum, and virtually coat it with an insulating paint. The high e.m.f. at the terminals of the cell under this condition they attribute entirely to IR drop of pressure in this high-resisting film. Others contend that the cell in the obstructive condition is the seat of a positive c.e.m.f., like the back e.m.f. of an electric motor at work. This difference of opinion resembles that which exists over the nature of the potential difference in the voltaic arc. In the latter case the phenomenon has been known for a longer time, and has formed the subject of more numerous investigations, so that the discussion has been more active and polemical. Some contend that the difference of potential at the voltaic arc is either wholly or substantially an IR drop of potential in ohmic resistance. Others contend for the existence of a true c.e.m.f. At the present time the advocates of resistance seem to have the best of the argument. The latest researches seem to indicate that of the fifty odd volts pressure at the arc, only a volt, or less, can be regarded as real c.e.m.f., like that of a voltaic cell, and the great remainder is due to the resistance of the carbon vapor column.

In the case of the aluminum cell, Mr. Cook seems to advocate the c.e.m.f. theory. Yet he admits that the film of material covering the aluminum anode—which he thinks is Al_2O_3—has a very high resistivity. Consequently, we have difficulty in precisely apprehending his conclusions. In the main, however, he regards the charged anions as being denied access to the aluminum anode by the superficial film of oxide. The negatively-charged anions are caught and arrested by this film, as torpedoes might be caught and kept from reaching the hull of a vessel by a torpedo-net. The layer of charged ions caught in the net constitute a layer which, according to the article, gives rise in some manner to a c.e.m.f. It seems reasonable, indeed, that the anions should be caught and massed together in this way; but the voltage of each anion cannot be more than about one volt, and the mechanism whereby the massing of such ions can build up a c.e.m.f. of some fifty volts is hard to realize. Moreover, if, as is admitted, the oxide film on the aluminum offers a high electrical resistance, then the passage of current through the film must produce a part, at least, of the observed potential difference.

During the steady flow of a unidirectional electric current through a conductor, it is usually impossible to tell whether the potential difference at the terminals of the conductor is due to resistance or to c.e.m.f. Take a thermo-electric junction, for example. If a current of one ampere determines a pressure of one-tenth of a volt at the terminals of the junction, there may be a thermo-electric c.e.m.f. of one-tenth of a volt and no resistance; or, there may be no c.e.m.f., but one-tenth of an ohm resistance; or, there may be partly c.e.m.f. and partly resistance. The power expended in the conductor by the current will be one-tenth of a watt on either hypothesis. The only hope of discerning which condition exists, during the continuance of the current, is to study the gradient of potential, and ascertain whether it be continuous or abrupt. If it be continuous, the inference is that resistance is involved. If it be abrupt, while the material is continuous, the inference is that c.e.m.f. is involved. In the case of the aluminum cell, the potential difference is developed in so short a distance that this test is hard to apply. When, however, the current is suddenly removed, there can be no residual c.e.m.f. if the effect is entirely due to resistance. On the other hand, if the effect be due to a real c.e.m.f. the latter generally persists to some extent after the removal of the impressed current. Thus, in the polarization cell, in the thermo-junction, in the magnetic circuit of hard steel, etc., the removal of the impressed current, or flux, leaves a clearly perceptible c.e.m.f. or c.m.m.f. In the case of the voltaic arc, no appreciable residual c.e.m.f. has yet been detected. The article mentions that when the current polarizing the aluminum-anode cell is suddenly interrupted, there appears to be a distinct and powerful residual c.e.m.f. If this exists in a circuit of negligible inductances, then this is indeed evidence of a real c.e.m.f. But apart from this, the remainder of the evidences cited in the article do not seem

to us at all conclusive. The subject should receive further investigation.

ALTERNATING CURRENT RAILWAY MOTORS.

We count ourselves fortunate having been able to present to our readers in our issue of last week so interesting a discussion as that in which Messrs. Lamme and Steinmetz played the principal rôles at the last Institute meeting. It not infrequently happens that during the progress of a discussion many important matters which have been—well, let us say secluded—in the papers themselves, find the light of day, and in this instance the tail certainly wagged the dog. The game opened with a very lucid and pertinent discussion by Mr. Lamme of the whole question of single-phase railway motors, including particularly a comparison between the series and the repulsion types, with respect to their design and properties. On the whole, Mr. Lamme's remarks were the most illuminating which we have yet heard regarding the new railway motors, and we commend them heartily to the careful attention of those interested in the subject. We do not altogether agree with the speaker's classification of the commutating single-phase motors. It seems to us that a sharp line should be drawn between the pure series-wound motor in which the currents delivered to field and armature flow in one and the same circuit and are dynamically in the same phase, and those in which the phase difference between the currents in armature and field is part of the organic theory of the motor. The pure series type to which Mr. Lamme has adhered is in principle and theory on all fours with the series-wound, direct-current motor. The latter, as is well known, does not reverse by reversal of the current at its terminals, but only when the reversal is as between armature and field. If such a machine is fed with an alternating current at one cycle per second, the same relation holds true, and so on up to the point where, with increasing frequency inductance and parasitic currents, block the game.

Mr. Lamme's work has been to plan the structural features of the motor so as to permit the frequency to be carried up to a figure within the range of commercial alternating practice, and so far as has transpired he has done a very workmanlike job. As he explains in the discussion, he has cut down the serious inductance of the field by making it very weak compared with the armature and by working at low saturation. He has provided a very powerful armature, thus throwing the main work upon the element of which the inductance is less serious, and, as we learn from his English patent, he has perforated the salient poles longtitudinally to lessen the otherwise great cross-magnetizing effect of the powerful armature. He has employed resistance in the commutator leads to diminish the effect of the coils short-circuited in commutation and has, in short, used to good advantage all the arts of the skilled designer. And he states in the most unequivocal manner, that the result has been to eliminate sparking as a practical difficulty. On the other hand, the motors developed by Winter and Eichberg and by Dr. Steinmetz belong squarely in the category of alternating-current machines. They deal with field magnetizations and currents displaced in phase and brought into harmony by establishing a fixed polar line in the armature through the agency of the commutator. They may be treated in theory as motors having rotary fields, although as we intimated in our notice of Dr. Steinmetz's paper, this treatment is not necessary any more than it is in the case of a pure induction motor. The repulsion motor invented by Prof. Thomson is one of the most ingenious and interesting of the alternating class and possesses many of the most valuable properties of a pure series motor. In fact, the series characteristics making it essentially a motor for vairable speed undoubtedly stood in the way of its progress when it was invented, the demand then being for motors of inherently constant speed. Now, freed by the progress of the art, like the series motor, from the incubus of high frequency, it has been developed into a machine of great and immediate value.

As regards the relative merits of the two types, it is too early to speak from experience. Each type must in practice transform down for the armature the voltage of the trolley wire. The series motor does this by a separate transformer, the repulsion motor by transformation in the motor. As between the two processes we are not inclined to think that there will prove to be any material difference either as regards efficiency or power factor. The losses will be distributed somewhat differently in the two. As Dr. Steinmetz pointed out, the repulsion motor will utilize less iron and more copper and works its iron at higher density than the series motor. Up to the maximum voltage for which the fields of the repulsion motor can be wound, we should think it would have a material advantage in total weight of equipment over the series motor. At higher voltages than this it would lose such advantage. Both types can be used on direct currents, the series motor perhaps the more readily of the two, being the less separated in design from a direct-current motor. Both can return energy to the line by way of braking and the series motor can be, if need be, "slugged" like a direct-current motor. Both suffer from a poor power factor at starting, poor even compared with standard polyphase motors, against which low power factor is often discharged; but as Mr. Lamme pointed out, the actual volt-amperes taken in starting are not excessive owing to the efficient means of control available with alternating currents. The speed-torque curves of the two types are much alike, not differing more than would two motors of the same type but of different design, and when at or near normal speed the power factors are amply high in spite of a liberal air-gap, much larger than is usual in the polyphase motors.

As regards the practical working properties of these two types of motor, it is too early to speak with much certainty. Both Mr. Lamme and Dr. Steinmetz agreed that little can be told regarding the relative excellence of series and repulsion motors by experiments on one line of machines operated in both ways, for the fundamental elements of correct design differ in the two cases. Moreover, the game is as yet young and in a matter which depends almost entirely upon the *virtuosity*—to steal a word from Pharisees—of the respective designers, one could only guess at final results. It seems to be agreed that the sparking problem has been solved, within limits at least, and that in general operative properties the new motors will have most of the virtues of the ordinary ones, in addition to some peculiarly their own. Present indications are that the alternating motors will be materially heavier than the present standard railway motors, and also by a few per cent. less efficient. We have little doubt that further experience will relieve one or the other of these conditions, but hardly both unless at great additional cost of construction. However, as we have repeatedly stated, the efficiency of the worst of the newcomers compares favorably with the efficiency of the best direct-current railway motor with a rotary converter tied to its tail. Also, the small increase in weight of motor may be considered as merely of an academic interest, since the proportion of dead weight to live weight in any motor car is large and varies far more from one type of car body to another, than in virtue of a change in motors. Nobody protests at a few hundred pounds extra weight in a new and elegant car body. As for the motors, time will tell.

Telegraphic Work in Baltimore During the Fire.

The experiences of the telegraph companies during the great Baltimore fire last week were quite thrilling, and we believe that many of our readers will be interested in the narrative given below of the ordeal undergone by the staff of the Postal Telegraph-Cable Company. Elsewhere in this issue are some other data regarding the more fortunate escape from destruction of the light and power plant of the United Electric Light & Power Company.

The main office of the Postal Telegraph-Cable Company at Baltimore was located on the twelfth floor of the steel skyscraper of the Continental Trust Building on the corner of Baltimore and Calvert Streets. A large force was on duty during the conflagration and when it became evident, about 7 P.M., that there was danger of the destruction of the building all wires north and south were connected through in the subway terminal room in the basement. The records and some apparatus were hurriedly moved to a branch office about half a mile from the main office and other apparatus was packed and taken to the ground floor ready for removal.

At 9.15 P.M. the Continental Trust Building caught fire, burning rapidly, and the operators were compelled to leave, barely having time to get out. The rain of fire in the streets was so intense that Superintendent Lemon, Manager Moore and Cashier White, the last ones to leave the building, had to run for their lives, abandoning the instruments that had been carried as far as the door step. The force then groped their way to the branch office, being drenched to the skin by a bursted hose en route, only to find that that office was also on fire and that the records and apparatus previously removed from the main office had been consumed. The terminal poles where the underground cables meet the aerial lines in the northern and southern sections of the city were then visited, temporary quarters were secured near them, and offices opened for business. These offices were in operation before midnight, one of them being in a Hebrew sweatshop amid surroundings that were far from agreeable.

The executive department in New York was apprised of the conditions and the first morning train leaving New York for Baltimore carried the Postal's portable quadruplex telegraph plant, consisting of an engine, dynamos, switchboard, motor transformers and quadruplexes arranged in cases in such a manner that they may be placed in operation in a few minutes after arrival at destination. Superintendent Lemon had secured new headquarters for the company at 219 North Calvert Street early on Monday morning and immediately begun stringing wires to that point, but unfortunately was short of instruments with which to work them, all spare apparatus and instruments, despite the efforts to save them, having been lost in the fire which burned both main and branch offices.

The portable multiplex plant and an ample quantity of spare instruments shipped from New York reached Baltimore about noon, but owing to the difficulty of obtaining trucks it was impossible to get them delivered until about half-past 5 P.M. A half hour later a full outfit of quadruplexes was in operation. By the following (Tuesday) morning the operating force of the company had been consolidated at the new office, a commissary department had been established, furnishing all employees with coffee and food, connections had been made from the underground system to the new office, and all wires cut into the switchboards there.

The wires cut through in the terminal room in the Continental Trust Building remained in working order between New York and Washington until about 3 o'clock on Monday morning, when they failed. An examination made by Mr. Skirrow, assistant electrical engineer of the company, on Tuesday morning, as soon as it was possible to get at the terminal room in the heated ruins, showed that the iron terminal frames had stood intact, but that the insulation and lead covering on all wires and cables in the room had been entirely consumed. He immediately restored the connections, although parts of the basement were then burning and continued to burn until Tuesday evening.

In addition to the regular force in Baltimore, Superintendent L. Lemon, of Philadelphia, was on the ground from 2 o'clock on Sunday; Superintendent of Construction W. H. McCollum, with several men, arrived early Monday morning, and Mr. Skirrow, with J. F. Needham and several assistants in charge of the emergency apparatus, arrived Monday noon. Mr. T. E. Fleming, special agent, went from New York to Baltimore on Tuesday and assisted in the permanent reorganization of the delivery and accounting departments.

The efforts made and the work done by the entire force elicited the highest commendation. Everyone forgot himself and worked with might and main to re-establish the service. Although nearly every employee suffered some personal loss, operators losing their typewriters and messengers losing their bicycles, etc., not a word of complaint was heard and, despite cold and hunger, every man and boy worked all day and all night and again the next night without rest until the service was fully restored.

So far as transmission on the wires was concerned, the traffic was handled with comparatively little delay even on Monday, but the company experienced very great difficulty in delivering the business, it being almost impossible under the conditions prevailing for messengers to find addresses. The local post-office, however, had escaped and the post-office people were sorting mail matter promptly and business houses were calling at the general delivery windows for their mail. The Postal Telegraph Company, therefore, immediately dropped into the post-office and telegrams which could not be promptly delivered by messenger and in this manner effected deliveries of telegrams as expeditiously as possible under the circumstances.

In the meantime, the regular messenger delivery service was rapidly being re-established by means of a card index on which new and temporary addresses were systematically entered as quickly as they could be collected. The regular deliveries were still further expedited by the use of a special "outlook" envelope, the front of which was partly composed of translucent paper, so that the address of the original message could be read through the envelope, thus obviating the necessity for addressing it.

The prompt and efficient restoration of the telegraph service did more than any other one thing to assist in bringing order out of chaos and in allaying the apprehensions of business houses throughout the country by making it possible for them to communicate promptly with their Baltimore correspondents and thus learn the status of their business affairs. Notwithstanding the fact that the volume of commercial and press business handled during the three or four days succeeding the fire was very largely in excess of the normal business, it was handled with remarkable promptness.

The Pratt Street Power House in the Baltimore Fire.

One of the remarkable features of the great Baltimore fire was the saving of the Pratt Street power house of the United Railways & Electric Company, with all of its valuable electrical machinery, although the building was in the midst of the conflagration. The saving of the house and its contents was a piece of great good luck for the whole city, as well as for the company that owned it, as it permitted of the starting up of the street railway service within 24 hours after the fire was under control and a resumption of service which otherwise might have been delayed for weeks.

The power house consisted of three sections, the first section being the old power house, in which was installed direct-current apparatus; the second section is the boiler room, and the third section is the new plant, in which is installed four Westinghouse 2,000-kw, 132,000-volt, three-phase, fly-wheel type, alternating-current generators. The bus-bar structure is in the basement and over this are installed the oil switches, three for each generator and three for each feeder. The control of these switches is in a gallery built at the end of the generator room.

The old part of the power house was destroyed, and in the new part, where the new generators are located, the basement was flooded with water nearly up to the bottom high-tension bus-bar. The building in which this machinery was installed, however, is absolutely fireproof, the window casings and frames being of copper and the glass provided with wire netting. While the flames raged all around, the building did not suffer and in fact a cat which was in this power house came through alive. The old power house burned early Monday morning; by Tuesday afternoon at 5 o'clock the water had been removed from the basement of the new section, test had been made of the Westinghouse apparatus, and the result was that the machines were placed in operation at this hour and started in to furnish current to the sub-stations, and have been running ever since without difficulty.

Annual Dinner of the American Institute of Electrical Engineers.

THE annual dinner of the American Institute of Electrical Engineers, held Thursday, February 11, at the Waldorf-Astoria, was an event of unusual importance in Institute annals and in electrical history in America. It celebrated the twenty-fifth anniversary of the practical perfection and commercial introduction of the incandescent lamp, and the dinner occurring at an opportune season of the year was associated also with Mr. Edison's birthday. A few months prior to the affair, the Edison Medal Association was formed to found a medal in the Institute which would signalize this anniversary in electric lighting development, and at an early stage it made arrangements with the Institute dinner committee so that the dinner might be devoted more particularly to the celebration of the anniversary. If the reports of the daily press are to be taken as any criterion, the affair was one of the most notable of the kind celebrated in recent years in this city, the New York *Herald*, for example, speaking of it as a banquet that for novel effects in decorations, ingenious souvenirs and noteworthy messages of congratulation probably was never eclipsed. The Institute dinner committee comprised Messrs. Calvin W. Rice, chairman; Arthur Williams, T. C. Martin, Charles W. Price, E. H. Mullin, Calvert Townley, F. C. Bates, Bancroft Gherardi, Jr., and W. J. Hammer, with whom were associated Messrs. R. R. Bowker and Frank J. Sprague on behalf of the Edison Medal Association. The officers of the Medal Association contributing actively also with its executive committee to the success of the event were Messrs. Samuel Insull, chairman; Charles Batchelor, vice-chairman; Frank S. Hastings, treasurer; R. T. E. Lozier, secretary.

THE MAN AND THE LAMP.

The banquet was given in the grand ballroom of the Waldorf-Astoria at 7.30 and was preceded by a reception to Mr. Edison at 6.30, when he received the congratulations of the guests assembled, numbering not far short of 500, and including well-known and distinguished people in scientific, artistic, technical, literary, financial and commercial circles. The ballroom was most elaborately decorated for the occasion under the direction of Mr. Arthur Williams, and has never looked so well. In addition to the regular incandescent lighting, the tiers of boxes were all elaborately festooned with Elblight cable and lamps entwined with smilax, and incandescent lamps also adorned the speakers' table in long festoons. Back of the speakers' table were draped American flags and a pyramidal arrangement of 57 incandescent lamps, and in the middle was a handsome oil painting, loaned by Mr. W. J. Hammer, of the modest little house at Milan, Ohio, where Mr. Edison was born, in 1847. Above it was the shield of the State of Ohio and on the two sides were the shields of New Jersey and New York, as being those States most prominently identified with his inventions and work. The menu prepared for the occasion was a sumptuous piece of work, being vellum quarto of 12 pages and cover printed in blue and gold, and containing a portrait in color by the Ives process made from a well-known bust of Edison. This Mr. Edison had been good enough, at the request of the dinner committee, to autograph in advance, so that every guest carried away a memorial which of itself was valuable and interesting as a souvenir of the occasion. The "end covers" of the menu were elaborately worked out in gold, with the initials of the Institute and of Mr. Edison encircling magnets and incandescent lamps; and the same motif was reproduced as a border for each page. The menu included also two sextets written for the occasion by Mr. R. R. Bowker, which are quoted below, one novelty in connection with them being the fact that they were not written out but were dictated directly to the phonograph.

The dinner committee had also prepared a number of other interesting conceits and surprises which added greatly to the charm and interest of the occasion. The stick pins for the boutonnieres were little incandescent lamps furnished by the General Electric Company. The cover of the sorbet box was a large reproduction in old ivory celluloid of the statue of the Genius of Light made by the Italian sculptor, Bordiga, and now one of the prominent features of the library at the Edison Laboratory. The ices were molded in the form of incandescent lamps and were brought in in a procession by some 40 or 50 waiters, each of whom carried a large pastry model of some electrical device or invention, including huge reproductions of the early Edison dynamo, the Edison phonograph, a multipolar machine, resistance boxes, electric automobiles, badges of the Institute and other effects. All these and sundry other details were received with great enthusiasm by the occupants of the ballroom who, it may be noted, included 150 ladies, most of whom were in full evening dress. The rostrum, or speakers' table, was occupied by President B. J. Arnold, having Mr. Edison on his right as the guest of honor; Prof. Elihu Thomson, Prof. C. F. Brackett, Dr. A. E. Kennelly, President C. A. Coffin, of the General Electric Company; President Ambrose Swasey, of the American Society of Mechanical Engineers; Mr. John Fritz, Mr. Samuel Insull, president of the Edison Medal Association; Mr. C. L. Edgar, president of the National Electric Light Association; Mr. Joseph B. McCall, president of the Association of Edison Illuminating Companies; Mr. W. H. Fletcher, president of the Engineers' Club; Col. R. C. Clowry, president of the Western Union Telegraph Company; Mr. A. B. Chandler, president of the Postal Telegraph-Cable Company; Mr. George G. Ward, president of the Commercial Cable Company; Mr. W. J. Wilgus, vice-president New York Central Railroad; Mr. J. J. Carty, president of the New York Electrical Society; Mr. C. F. Scott, chairman of the Union Engineering Building Committee of Fifteen; Mr. R. W. Pope, secretary of the Institute, and Mr. T. C. Martin, toastmaster.

After the service of the dinner President Arnold called the company to order and read the following message from President Roosevelt:

THOMAS A. EDISON, Waldorf-Astoria, New York:
I congratulate you as one of the Americans to whom America owes much; as one of the men whose life work has tended to give America no small portion of its present position in the international world.

The reading of this dispatch was received with great applause and a standing toast was drunk to the health of the President of the United States. Mr. Arnold then delivered an interesting speech on the Institute and its relation to the affair of the evening, in the course of which he said:

We have met on this, the day of our annual feast, not only to renew the friendships incidental to those engaged in a common cause,

but to assume an obligation which, if administered faithfully by us and our successors, shall tend to stimulate the ambition of many of our student class and bring to some of them that intangible something called success. If you ask me what is success, I cannot answer; but those whose ambition is to add to the sum of human knowledge or accomplish something for the material advancement of the race, need no answer.

It is to this class of young and ambitious men that our attention is directed to-night. If, in the future, they need inspiration, let them recall this occasion and remember that around these tables sat men who were the exponents and active agents of one of the greatest forces in nature, and that through their achievements in mastering this silent force, there was effected in a brief period of but little over twenty years one of the greatest advancements in material wealth and scientific knowledge in the history of the world.

Either around these tables sit, or associated with us in similar societies across the waters are the men, who, through their efforts have converted our cities from darkness into day, increased the range of human speech, bridged our oceans for the transmission of intelligence, with and without wires, made it possible to preserve the human voice long after the speaker has passed away, emancipated the horse, and who bid fair to continue to eliminate the element of distance in the transmission of electrical energy until the steam locomotive, formidable rival that it is, shall have been emancipated to its final extinction.

It is especially fortunate that our profession is so young that we can select for our first distinction the one whom we all agree is now the most deserving and instead of honoring him after he has passed beyond the appreciation of earthly honors, we are able to have him with us to-night, to see and to feel the esteem in which he is held by his protégés, who recognize in him not only a man of great natural genius, but also the exemplification of what has been defined as genius itself, "the ability for hard work." Therefore, as the dean of the greatest technical school of the world through which the graduates of all other schools must pass, the school of practical experience, and in which school he has eclipsed us all in individual achievement in those arts which tend for the material benefits of his race, do we recognize him and by these ceremonies honor ourselves in thus honoring and officially perpetuating the name of Thomas Alva Edison.

At the close of his remarks Mr. Arnold introduced Mr. Martin as toastmaster, who, in proposing the health of the guest of honor, said:

The American Institute of Electrical Engineers is proud to embrace in its membership to-day the foremost inventors of the age and the greatest captains of industry, and has placed upon its golden tablets many an auspicious discovery and art to celebrate. But it surely could find no worthier hero among them and no better gift to mankind to signalize than the man and the lamp around both of whom we twine to-night the laurel wreaths of our admiration and our love.

There should be encouragement in the founding of this medal to-night for every struggling, ambitious youth in America. Let us and let our sons recall and applaud the cheery little newsboy at Detroit; the half-shod, half-frozen operator seeking bravely a job along the icy pikes of the Central States; the gaunt, untutored experimenter in Boston, taking eagerly needed fees for lectures he was too modest to deliver; the embryonic inventor in New York, grubstaked by a famous Wall Street man for his first stock ticker; the deaf investigator at Menlo Park who wreaked unique retaliation on his affliction by preserving human speech forever with his phonograph; the prolific patentee who kept the pathway to the Patent Office hot with his footsteps for nearly forty years; the genius, our comrade, who took this little crystal bulb in his Promethean hand and with it helped to give to the world a glorious new light which never was before on land or sea—Thomas Alva Edison.

Mr. Edison had declined to make a speech of acknowledgment, but had consented to wire his response, and to carry out this purpose the Western Union Telegraph Company had furnished for the evening an Edison quadruplex set with an extension key, so that Mr. Edison could send his message without leaving his place. The message was received at one end of the speakers' table on a portable Postal quad set by Mr. A. B. Chandler, who, a great many years ago, gave Mr. Edison his first official position by making him electrician of the old Atlantic & Pacific Telegraph Company. The wires were carried above the table on a regular pole line. The message was transmitted at the same time over a wireless telegraph system between the table and the other end of the banqueting room, installed by the Marconi Company. Mr. Edison's reply was as follows:

I want to thank first of all my fellow-members of the American Institute of Electrical Engineers for the great honor done me in thus celebrating my birthday, associated with the twenty-fifth anniversary of the completed development and successful introduction of the incandescent lamp. Your expressions of good will gratify me deeply. While I cannot but rejoice at the place which the incandescent lighting art has made for itself among the inestimable comforts and conveniences of civilization, I feel that my share in the work is exaggerated by this prominence given me to-night.

To my old friends and associates who have founded the Edison Medal in the Institute—I can but extend you thanks again. If I could do it in return, I would found a medal for every one of you, for you are just as much entitled to recognition as I am. You gave me your friendship and loyalty, your watchful days of toil and sleepless nights of anxiety. Some of you helped to perfect the art by your engineering skill, your legal ability, your financial aid.

The early days were enough to tire our any one's courage and persistence, but you stood it all, and put up with me into the bargain. Now, in noble revenge for the burdens I put on you, and in addition to all the evidences of friendship in the past, you add this unusual token of continued affection. I should not be human if I were not profoundly affected and deeply grateful.

This medal is founded to encourage young men to devote their best thought and work to electrical development. I rejoice in this stimulus to harder study. Better trained and educated than were we pioneers of the times before every college and university had its electrical course, these coming men of the future should, and I believe will, carry forward to triumphs and arts heretofore undreamed of, the principles and applications of electricity to which I have tried humbly to devote my life and energies from the hour my hand first touched the key. God bless them, and you, my dear friends, and this American Institute of Electrical Engineers.

While the message was being sent the toastmaster read selections from a number of congratulatory messages, cablegrams and telegrams received, including the following:

Hearty congratulations birthday; sorry not present celebrate 25th anniversary your great invention. MARCONI.

It is most unfortunate that I cannot be present when the "King of the Telegraphers" is to be crowned with the Medal Crown. Though absent, yet I here profess to the monarch loyal and unfaltering allegiance, swearing to render him at any and all times such service as the most potent head of the clan that ever ruled his people, ever received from his humble and devoted subjects.

To which I hereby pledge our life, our fortune and our sacred honor. Long life "King Edison the First." ANDREW CARNEGIE,
Liegeman to King Edison the First.

"73" to one and all.

Ohio claims a large share in the glory of Mr. Edison's career by reason of the good start she gave him. The people of Ohio are deeply interested in his great achievements and rejoice over the fame he has won.

Speaking as the representative of Ohio, and for myself, I join you in felicitations to the guest of honor, and extend to him my best wishes for many years more of usefulness.

MYRON T. HERRICK,
Governor of Ohio.

Will you be kind enough to extend to Mr. Edison my sincere congratulations upon his fifty-seventh birthday? It is hard to realize that so many wonderful achievements could be crowded into the brief space of years since Mr. Edison arrived at manhood. It is still more difficult to appreciate the full effect of his inventions; what they mean to the civilized world in added comfort, economies, in expediting business and in bringing the whole world in closer communication.

With the friends who will surround him on this occasion I beg to join in extending best wishes for many years of usefulness and honor. BENJAMIN B. ODELL, JR.,
Governor of New York.

I am glad to know that the American Institute of Electrical Engineers propose to do special honor at their annual dinner to Mr. Thomas A. Edison, a distinguished citizen of New Jersey, whose remarkable achievements have been an honor to his State and country and of the highest usefulness to mankind.

Few men in history have found so wide a range for their inventive genius, and perhaps no one has contributed more by his inventions to make life safer, or more enjoyable or happier than he. New Jersey is proud of him, not alone for his wonderful achievements, but for those sterling qualities of manhood that make his life a model and an inspiration to all. FRANKLIN MURPHY,
Governor of New Jersey.

From President Francis, of St. Louis Fair.

Extend my warmest felicitations to Mr. Edison and assembled guests. I wish to express my admiration for the genius of mind and craft of hand that have accomplished so much in a quarter of a century, and I hope the presentation of electricity at the coming universal exposition will fittingly evidence these great achievements. The Exposition is honored in having Thomas Alva Edison high on the roll of its honorary chiefs. D. R. FRANCIS.

From Lord Alverstone, Lord Chief Justice of England.

Hearty good wishes to Mr. Edison. I look back with greatest interest to his brilliant inventions in electric lighting and telephony, which I had the great pleasure of successfully maintaining in all the courts in England.

From Lord Kelvin.

I join heartily with the American Institute of Electrical Engineers in gratitude to Edison for his great electric work and for the phonograph, a most exquisite and instructive scientific discovery, and for

his many other useful and well-worked-out inventions for the public good.

From Prof. Colombo, Italy.
I enthusiastically join in the honors paid to-day to my dear and illustrious friend Edison, whose system I am proud to have introduced first into Italy.

From E. De Fodor.
Admiring your great inventions, Hungarian friends send sincerest congratulations.

From Paris.
The electricians of France send their heartiest congratulations to Mr. Edison on the occasion of the ovation in his honor. MASCART.

From Berlin.
Greeting and kind wishes to American engineers. Congratulations to Edison on the twenty-fifth anniversary of his inventing the glow lamp. GISBERT KAPP.

Hearty congratulations to our honorary member of the Elektrotechnischer Verein. EMIL NAGLO.

From the Italian Society of Electrical Engineers.
Honor to your illustrious guest. Fraternal greetings to the American Institute of Electrical Engineers. ASCOLI.

Other messages were received from Mayor McClellan; the president of the English Institution of Electrical Engineers; Francis Jehl, Joseph Wetzler, G. A. Hamilton, C. P. Bruch, etc. It is needless to say that Mr. Edison's health, his response and the messages were all received with immense applause and enthusiasm.

The toastmaster then remarked that Englishmen had always been prominent in the work on the incandescent lamp, and that they had with them that evening Mr. Charles Batchelor, to whose brilliant work the perfection and successful introduction of the lamp in this country was so largely due. Another Englishman brought over by Mr. E. H. Johnson had been with Mr. Edison as his private secretary and confidant all through the period of storm and stress and was now lighting one of the dark places of the world with the Edison lamp, Mr. Samuel Insull, president of the Edison Medal Association.

Mr. Insull then presented to the Institute the Medal Fund and the Deed of Gift in connection therewith. He recited details from the Deed of Gift as to the nature and objects of the medal, which he characterized as the blue ribbon of the profession. He then proceeded in some brief, well-chosen remarks to outline the extent and importance of Mr. Edison's work; and while he did not minimize the lamp, showed it was but one detail in a vast and extensive system upon which depended the erection of an entirely new art.

Those prominent and distinguished experimenters who, prior to and contemporaneously with Mr. Edison, sought to produce a commercial incandescent lamp, followed the path hewn out for them by the early series arc light experimenters. They, as a result, made the mistake of producing a low-resistance lamp operating in series, and consequently requiring a varying potential, resulting in a system impossible to operate on a large scale. It remained for Mr. Edison, with a foresight almost supernatural, to see that what was needed was a constant potential system which would respond to the demand of every kind of service, and as a result he gave us the high-resistance lamp, the multiple-arc and feeder systems, embodying principles which all successful inventors have since been compelled to employ in their distribution systems—whether dealing with direct or alternating currents, with systems of lighting (except series-arc lighting), and with systems of electrical power, whether moving or stationary. In short, Mr. Edison gave us as the result of his brilliant inventive work at Menlo Park, the cardinal engineering principles of the great industry with which his name is so intimately associated, and in making these contributions to scientific and industrial progress he achieved such a position that I think posterity will not adjudge us of undue enthusiasm if we name him as the greatest electrochemical experimenter and the first electric light engineer of his day.

It is not alone as the experimenter and inventor, as the mathematician and engineer of this industry for which Mr. Edison is entitled to recognition. It should be borne in mind that at the time of his first exhibit of his light and power system on a considerable scale at Menlo Park in the winter of 1879-80, there were no factories for the production of the apparatus required for use in connection with the system, nor were there in existence, except in their crudest state, any of the numerous appliances used between the generator and the lamp, and which have since become every-day necessities. These appliances had to be developed and factories for their manufacture organized before it was possible to build the first plant and distribution system which was successfully started in New York in the fall of 1882. Things which to-day we do as a matter of course, because they have been done by others before us, presented great difficulties in the first ten years of the twenty-five years which this occasion marks. All these matters were dealt with under the guiding hand of Mr. Edison himself. The credit of carrying his great work as an inventor to a successful commercial issue is, therefore, due to him, and thus, besides being the inventor of his electric light and power system, he was in every sense the captain of the great industry resulting from his successful laboratory work.

I will not attempt on this occasion to mention the other branches of electrical work in which Mr. Edison has so greatly distinguished himself as an inventor and in connection with which he has contributed so much to the industrial development of our time. What he has done outside of the electric light and power field would be a sufficient life's work for most men.

The work that he has accomplished should prove a great inspiration to future generations of students of the electrical engineering profession. When, as a result of competing for the Edison Medal, which we hope will prove, so to speak, the blue ribbon of the profession [applause], they study the life of the great master after whom this prize is named, they will find that without any of the advantages of collegiate education, without any early training except that gained as a train boy and telegraph operator, blessed with little beyond a quick mind and a strong constitution, but with a will to work and a great power of concentration, this country boy from the West rose from so lowly a beginning to be the foremost electrical inventor of his time. [Applause.]

Dr. A. E. Kennelly, of Harvard University, past president of the Institute, then accepted the medal on behalf of the Institute and in thanking the members of the Edison Medal Association said:

I want, on behalf of the American Institute of Electrical Engineers, to voice our universal sentiment in expressing our appreciation of the cause which you have founded as a worthy and enduring monument to the fame of Mr. Edison. In the old days of Greece, in the days which were said to belong to the heroic time, men strove for the laurel crown. It was the idea of all men that the laureate wreath should rest upon their brow. To-day, in modern guise, and actuated by the more modern and altruistic spirit, this laurel wreath you have converted into a golden circle, that shall perennially flourish from year to year and pass from generation to generation to testify to the worth of the pioneer in whose honor it was founded. We want to thank you for what you have done in creating this fund. Not only do you incite enthusiasm in the young man, whose age is set forth in the deed as not to exceed twenty-five years; not only do you enhance the fame of Edison and perpetuate it in future years, but you also stimulate those institutions in which the future Edisons may be trained and engender this spirit of generous rivalry and emulation among the alma maters of this favored country. Broad and generous are the terms of the deed lying before us. Although our Institute is a corporation under the laws of the State of New York, this deed declares that any youth, of any country, educated at any college or institution from Texas to Labrador or to the Behring Straits, may qualify for this medal. Applied science and pure science know no barriers, and only understand and recognize the barriers of the unachieved and the unknown. The action taken here this evening should stimulate every worker in electrical interests all over this globe. I hope that this medal from year to year will inculcate some of the spirit in which this inventor strove and accomplished. It is a favorite saying of his that inspiration, in the main, is only another way of spelling "perspiration"; and that there is no secret so deep in nature, so recondite or remote, but persistent and ardent human labor will bring it to the surface. For that proposition this medal and this Institute stands. Moreover, you have set a golden seal upon this proposition—that pure science, or theory and applied science, or practice, are so closely connected, so intimately associated, in our modern life and in our modern dealings with nature, that the Edison medal cannot distinguish between them—that invention born of both throws lustre alike on both and forever will be a connecting link between them.

Prof. Cyrus F. Brackett, of Princeton University, was then introduced as one who had taught where Joseph Henry sat and who had had the distinction and honor of making the first scientific tests on the Edison lamp. He gave an interesting account of the manner in which these tests were conducted and spoke of the lively recollection he had of the difficulties encountered by Prof. Young and himself when, at the suggestion of Mr. Edison, they went to Menlo Park with such apparatus as the University then afforded to use in determining the efficiency of his dynamo employed in producing the incandescent lamp. Prof. Brackett said:

On behalf of the colleges and universities of the United States and Canada, I accept, with feelings of lively satisfaction, such responsibility as the founding and purpose of this medal confer.

It is fitting that such a medal be provided to bear witness to the skill and triumphs of the modest man whom we would honor on this occasion. I have said "would honor"; the fact is, that he has long been wearing, without affectation, the honors we are merely recognizing.

A mere enumeration of the things he has achieved would fill a very large and brilliant chapter in the history of applied science. His system of multiplex telegraphy, his invention of the telephonic transmitter, of the incandescent lamp, his system of electric distri-

bution, his improvement of the dynamo, his invention of the phonograph—all these and many more which time does not allow me to mention, are the reasons for the honors which are his by well-earned right. And these, in some way, symbolized by the medals which shall be struck in his name, will prove a mighty stimulus to those who shall strive to obtain them as the years go by. As this occasion marks the twenty-fifth year of the art of incandescent electric lighting, it may be of interest to glance backward, for a moment, to the condition of the art of illumination, as it existed more than twenty-five years ago. Outside the large towns, into which gas had been introduced, the "tallow dip" and the whale-oil lamp maintained a doubtful contest with the powers of darkness, tried the patience of the saints, but did not abate the profanity of the wicked. Then came the era of the so-called "burning fluids" which, although better, could hardly be called means of grace. In the early sixties oil was "struck" in Pennsylvania. As a result the great whales and the "tar-heelers" had rest. The sunshine garnered through the ages, poured forth in every hamlet and hut. The candle was no longer placed upon the candle-stick, and everybody praised the bountiful Providence which had prepared such a luxury.

If any one ever saw an electric light in those old days, he was one of the favored few who had access to the dingy laboratory of the college professor, who, on stated ocasions, exhibited it as it left the hand of Davy. It was a most interesting spectacle, the memory of which is even now treasured by those of us who witnessed it.

But, although this arc light was too powerful for purposes of general indoor illumination, it demonstrated clearly to those who could forecast the future that electricity would have its place in the art of illumination whenever its cost should not be prohibitive, provided convenient distribution could be made.

Such was the condition of affairs when Mr. Edison undertook the solution of the general problem of dividing the current and distributing it to small incandescent lamps suitably placed. He solved it completely, and if we require a monument to this victory we have only to look around. Wherever this man may go in the wide world his pathway will be lighted by the results of his own genius.

Mr. Joseph B. McCall, of Philadelphia, president of the Association of Edison Illuminating Companies, was then introduced as one who, while just a little too old to compete for the medal, was not disabled from enjoying an equal distinction, namely, that of winning the golf cup of the Association, and as representing the gentlemen numerously in evidence that night who were doing all they could to give the world the best shine for five cents. Mr. McCall prefaced his remarks with some very humorous and pertinent anecdotes, outlined the history of the Edison Illuminating Association, and alluded to the splendid example that would be given the growth of electric lighting in the Edison Memorial Exhibit at the St. Louis Exposition. He said, in conclusion:

The year 1882 saw a total production of incandescent lamps of only about 100,000. Ten years later the total consumption in this country amounted to about 4,000,000 yer year, and in 1903, practically twenty-one years after, the manufacture of incandescent lamps was commenced in commercial quantities, the total consumption in the country reached about 45,000,000 lamps per annum. Think of it, gentlemen! It is not many years since, when, in the larger cities of this country, a connected load of 100,000 16-cp equivalent was considered a mark to work to, while now it runs up into the millions. I do not know that there is anywhere a record of commercial results than can compare with this. It is unnecessary for me to say what this has also meant in the great improvements which have been made in all kinds of apparatus and appliances. You know them.

A splendid lesson of this growth will be given at the St. Louis Exposition bv the Edison Association—an Edisonian Exhibit, suggested by Mr. Insull, and now being prepared under his direction with great care and thoroughness, showing the great development from the small dynamos in the beginning to the great installations in the modern central stations. I am sincerely thankful for the privilege of being with your Institute to-night; grateful for the opportunity of paying my respects to the Great Man of Electricity, and I join your Society and guests in wishing for him many happy years, filled with continued good health, honors and successes.

The last speech of the evening was that made by Mr. C. L. Edgar, president of the National Electric Light Association. In calling upon him the toastmaster remarked that it was felt that the great perfection reached in the lighting art as a whole was due to the efforts of a great many distinguished and able men, among whom might be mentioned Elihu Thomson and Brush, Edward Weston and Swan, Wallace and Farmer, Fuller and Wood, Westinghouse and Hochhausen, Stanley and Steinmetz. The mention of the name of Thomson was received with long and continued applause, which did not cease until Prof. Thomson had risen to his feet and bowed. An ovation also followed immediately afterward in connection with the mention of the name of Mr. Coffin as a great captain of industry in the art and a great consolidator who brought it out of a period of chaos and confusion. Mr. Edgar said, in regard to the affair which had called them together that night:

I do not know who is responsible for the idea of the Edison Medal Association; whoever he is he deserves our thanks. I can conceive of nothing more appropriate than founding a fund, such as has been described here to-night, for the purpose not only of perpetuating Mr. Edison's memory and his work and his genius, but of perpetuating it among the class of young men to whom we must look for future development. I think it is particularly appropriate that the gold medal is to be given to the best work done by a member of the graduating class of one of our universities. I do not think that in the past there has been a very tangible connecting link between the students of our colleges and the men whose places they are to take in later life. I do not know how much the parent organization of the American Institute of Electrical Engineers is doing here in New York to bring them closer together. I do know, however, that the branch work which we are attempting to do in Boston and which I have no doubt is being done in other university centers is bound to have a very considerable effect in bringing closer together the students and the men engaged in the electric light industry in general. My recent connection with the Boston branch has shown me this more clearly than ever before. We have, as you all may know, in our vicinity, Harvard and the University of Technology, both having at least two large organizations of students taking an electrical course, and I venture to say that until the branch was organized scarcely any of them knew even by sight the class of men whom they themselves were likely to join in later life. What the branch work has begun in this respect will be made much more definite and tangible by the work inaugurated by the Edison Medal Association, and those in charge of its inception and carrying out are to be congratulated on having chosen a field, above all others, in which it will do the most good.

Before the assemblage broke up the New York Edison Company sent a photographer into the galleries and there an excellent picture was taken of the main table and 300 or 400 people still remaining. The explosion was very short, lasting only for a minute or two, and the picture is one of the best ever secured on a large scale by the means of the incandescent light. Thus closed fitly a memorable night.

The sextets written for the occasion by Mr. Bowker are appended:

LUX BENIGNA.

"Let there be light!" flashed the Creator's word,
And lo! the vibrant Vast with life was stirred,
Till last came Man. And Man is most divine
As he, with spark of genius, makes to shine,
Smiting the Dark to life, a living light
That into Day redeems the human Night.

FAMA ETERNA.

Blest is the man who, for his country dies;
Twice blest he who lives to serve mankind;
Thrice blessed he who, in life's little hour,
Searching God's treasure-house with lucent eyes,
A lamp for all men and all times may find,
And thrill the world with light, and heat, and power.

EDISON MEDAL DEED OF GIFT.

The Deed of Gift of the Edison Medal, as summarized by Mr. S. Insull, chairman of the Medal Association, provides as follows as to its chief features:

"1. The medal shall be awarded to such qualified student as shall have submitted to the Institute, in accordance with the provisions of this deed and of the regulations which may be prescribed by the Edison Medal Committee, the best thesis or record of research on theoretical or applied electricity or magnetism.

"2. Each competitor for the medal, in order to be qualified, must have graduated and received a degree during the year for which the medal shall be awarded, in some course of study at some institution of learning in the United States of America or Dominion of Canada, which course of study shall include the branch of electrical engineering. The United States Naval Academy and Military Academy are included within the institutions from which competitors may be qualified.

"3. Not more than two students may compete in any one year from any one institution of learning, nor may any student compete unless duly presented for competition through the faculty of the particular institution at which he is a student.

"4. The course of study must be one normally requiring not less than two years of continual residence and work.

"5. The thesis or record must not exceed six thousand words, not inclusive of words employed in explanation of accompanying drawings.

"6. No competitor shall be of greater age than twenty-five at the day of his graduation in such course of study."

Grounding of Constant Potential Systems.

By S. Bingham Hood.

THE object of grounding a constant potential system is to insure that under no possible conditions can the pressure rise above that normally on the circuit. This applies to all systems irrespective of the voltage at which they are designed to operate. The point at which the ground should be placed should be such that the pressure between the grounded leg and any other corresponding points shall be equal, or at the neutral point. Where it is impossible to obtain a neutral point then, of necessity, the attachment must be made to one of the other wires of the circuit, unless an artificial neutral is established.

To illustrate the object of grounding a system we will assume an arrangement of circuits commonly found in all large distributing systems (see Fig. 1). With all sections of such a system normally clear of grounds, the effect of accidental crosses and grounds will be taken up.

A ground on wire *a* gives a potential between ground and wire *b* of 5,500 volts; between ground and wire *c* of 7,700 volts. The same applying to accidental ground on wire *c*. With ground on wire *b* the potential to ground of wires *a* or *c* will be 5,500 volts. It is, therefore, clear that by permanently grounding wire *b* the possible potential is limited to the working potential of the circuit. Unfortunately, the general existing conditions prohibit such grounding on the high-tension section.

Most stations using high-tension feeders distribute either wholly or in part through underground cables. The first cables installed, some years ago, were insulated as in Fig. 2, each wire being insulated to withstand a pressure equal to that of the circuit, or double this

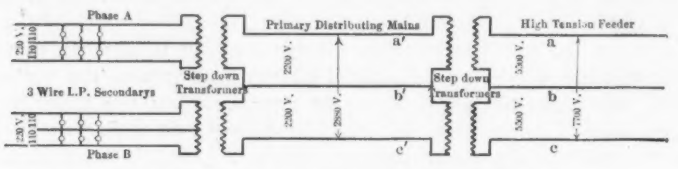


FIG. 1.—ARRANGEMENT OF CIRCUITS.

from wire to wire in the same cable. The several wires thus covered were built up into circular form and surrounded with a lead jacket.

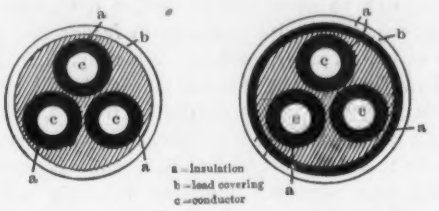
However, as the insulation between any wire and the lead sheath was only designed to withstand the working pressure, and when a ground occurs at any point on the system the factor of safety would be entirely wiped out, the result being a simultaneous breaking down of the insulation at other points on the system. In order to overcome this all new cables are, or should be, insulated, as in Fig. 3, the built-up cable having an insulation between it and the jacket equal to that on each wire. In this way a ground on any wire will not subject other points of the cable to potential above that for which it is designed to withstand. Unfortunately, the first type of cable is still largely in use, preventing permanent grounding until they are removed.

If a permanent ground were established it would not be necessary to place insulation on the grounded wire; consequently an additional amount of insulation could be placed on the other wires without increasing the cost.

Considering the middle stage of the system, the primary distributing mains, the same conditions apply as in the high-tension section; but owing to the lower voltage the danger of break-downs are not so great, but still exist to a very considerable extent.

Considering the effect of various grounds and crosses between the high-tension and primary systems, assume first a cross between wires *c* and *c'* with both systems clear of grounds, and no indication of trouble. A ground now occurring on wire *a*, the potential to ground of wire *c'* will be 7,700 volts, *b'* 9,900 volts, and *a'* 10,580 volts. This is the most severe condition which could exist, other combinations varying between this and a minimum of 5,500 volts, which can readily be determined by the data of Fig. 1. Should such a combination occur there would be an immediate break-down of the insulation at some point on the primary mains. With a primary system in first-class condition the weakest point would probably be between the coils of transformers feeding the consumers' premises, the breaking down of which would subject the inside wiring to a potential to ground of anywhere between 2,620 and 10,580 volts. The resulting disturbance requires no description. That such a result is seldom known to occur is explained in two ways: First, the general insulation of the primary system is seldom as high as that of the transformers connected to it, but the general improvement in overhead construction is rapidly removing this safeguard. Second, where such a break-down has actually occurred there is rarely enough left of the general combination, including the building where final ground connection was made, to tell what the original trouble was.

By permanently grounding wire *b'* any crosses between the primary and high-tension system would result in grounding the high-tension



FIGS. 2 AND 3.—SECTIONS OF CABLES.

wire upon which the cross occurred, either directly through ground connection on *b'* or through the transformer coils from wires *a'* or *c'*. It would, therefore, be impossible for any trouble, between these two systems, to spread to the low-tension secondary mains or to cause serious damage to the intermediate primary system. With both wires *b* and *b'* grounded it would be impossible for damage to result at any point except that where cross actually occurred. The same arguments apply to crosses between primary and the low-tension secondary mains, so that it is unnecessary to go into details as to the last section of the system.

The successful and safe operation of any constant-potential system requires that its voltage to ground must never exceed under any condition that normally on its circuits. From the above it should be clear that the only method of insuring such results is to permanently ground one wire of the system, and such grounding should be made compulsory in all cases where it is operated in conjunction with, or in the vicinity of, those of higher potential.

The illustrations and figures given above are taken from a three-wire, two-phase system, as offering the severest conditions to be found in practice. Single-phase, three-phase star, or delta, or combined star and delta give generally a slightly lower maximum voltage on the conditions shown above.

It is now necessary to consider the conditions to be met by grounding the low-potential distributing mains, an illustration of which, for future reference, is given in Fig. 4.

All low-potential circuits requiring over 660 watts should be wired and operated on the three-wire system, unless the load consists of one receptive device requiring over this amount of power, in which event it should be operated wherever possible from the outer wires of the system, thereby preserving the balance and requiring considerably less weight of conductors. The two-wire system, besides requiring an excessive investment for conductors, does not readily permit of grounding, owing to the grounded leg carrying the same amount of current as the other wire.

In a properly balanced three-wire system the neutral wire carries only a small percentage of the total current. By placing the per-

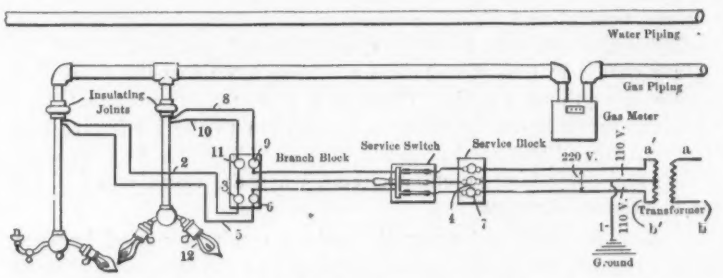


FIG. 4.—DIAGRAM OF GROUNDED CONNECTIONS.

manent ground on this neutral, should it accidentally open, the ground connections would not be called upon to carry any large amount of power; consequently, they need not be made as heavy or with as much care as would be necessary for their operation on a two-wire system.

A grounded direct-current, two-wire system might, under certain conditions, result in severe electrolytic action upon other metallic

structures in its vicinity. This would not be true of a three-wire system, as the neutral current would be of small amount, and in most cases of an alternating character, reversing at each change of the unbalanced load.

Referring to Fig. 4, we will assume that ground connection 1 is made by a driven pipe or small plate buried in moist earth, the resistance of which under even the most favorable conditions will seldom be less than 50 ohms. With wire *b* (Fig. 4) grounded, a cross between wires *a* and *a'* will allow, with ground resistance above, a current of about 46 amp. to flow at a pressure of 2,310 volts. On a branch primary line or individual transformer this would probably be enough to open the protective device on the primary circuit. However, should wire *a* be a main feeder this current would not open the circuit-breaker, and, consequently, this current would continue to flow through the ground pipe and still leave all points on the secondary system at a potential of from 2,090 to 2,310 volts to ground. In addition, the wire, frequently uninsulated, leading from the line to this ground connection, would also be at this potential to ground, and a person touching it while standing on the street would probably receive a fatal shock. The writer recalls one instance where the drop of potential was between such a ground and a street railway track about 15 ft. distant, and a horse crossing the line between pole and track received sufficient current to cause him to shy and turn around in line with the current path. The drop of potential through the earth between his hind and fore feet was then sufficient to instantly kill him, although at no time was he in actual contact with the charged pole or the railway track. This is one of the most forcible illustrations of the dangers of imperfect grounding.

While this current was flowing it will be supposed that the insulation to ground at point 2 was destroyed, and a low-resistance connection established to piping or other conductor connected to ground. This would produce a short-circuit at 2,310 volts through the house wiring and neutral service, resulting in blowing of fuses 3 and 4. The high potential would then establish a destructive arc at these points, probably starting a fire before the large breaker on *a-b* could open. This is identically what would happen under the same conditions if the ground pipe or plate had been omitted. It is, therefore, clear that a ground of this character, while furnishing protection in some cases, is worse than useless, as it furnishes a fancied protection, which in reality does not exist.

Considering the secondary feeders as being clear of other systems, a ground is placed at 5 on wire *b'*. There will now be a circuit established through the accidental and permanent ground, with a resistance of 50 ohms, neglecting resistance of wires. This allows a current of slightly over 2 amp. to flow, or insufficient to blow the fuses at either 6 or 7, and there being no indication of this trouble it would be allowed to exist. This places all points on wire *a'* at a potential of 220 volts to ground, with neutral at 110 volts to ground, being the same as if the ground connection at 1 did not exist. A ground occurring at 8 on wire *a'* would produce a 220-volt short-circuit between 5 and 8, probably blowing fuses 6 and 9. These fuses could not be replaced until one of the grounds is removed. Assuming that the one at 5 is cleared, then ground 8 allows the same conditions to exist on the opposite side of the circuit or system.

Instead of this combination we assume that ground occurred at 10, with ground 5 still on. There is then a 110-volt short-circuit between neutral and *b'*. The wireman sent to repair this does not readily locate grounds 10 or 5, gets disgusted, reverses circuit by placing wire 5 in fuse 3, and wire 2 in fuse 6, puts in the fuses and reports everything O. K. There are now two "permanent and effective" grounds on the neutral, in addition to the ineffective one at 1. All is well and good until a cross occurs between the secondary system and some high-potential circuit, when the result is a job for the insurance adjuster.

Another frequent and generally serious result is caused by fuse 11 blowing before fuses 6 or 7, resulting in 220 volts being thrown into all receptive devices on circuit 12, and in their immediate and violent destruction.

If the ground connection, 1, were made to an underground piping system the resistance would not be over one or two ohms, in which case a cross between a high-potential circuit would immediately open its protective device and also prevent such a high potential from reaching the main part of the consumer wiring before such device had opened. It would also be impossible to hold a fuse until the grounds occurring on the outer wires had been removed. It would still be possible to clear these grounds by reversing the two-wire branch, throwing the ground on the neutral; but this would not be likely to have any serious results owing to the low resistance of the permanent ground. A method of preventing this reversal will be taken up later.

It is, therefore, evident that a neutral permanent ground must be required, but that such ground must be of extremely low resistance. The only method of obtaining such a ground is by attaching to an underground piping system. This cannot readily be accomplished below the ground level, owing to the necessity of opening the street to reach such a pipe, and to the difficulty of obtaining a satisfactory and permanent connection when the pipe is buried in the earth and subject to all street disturbances.

The only practical method is to attach to a gas, steam or water pipe on the consumer's premises. This should be made before reaching the consumer's service block or switch, and to the service side of any gas meter.

Every consumer should be so connected in order to insure that the removal of one connection may not leave the entire system unprotected. In the case of consumers fed from individual transformers at least two grounds should be made in order to insure that failure of one will not permit the system to operate ungrounded. In the case of a large secondary network there would be a multiplicity of grounds capable of carrying many times the total current on the system.

In buildings of timber construction it would be well to require that the gas meter outlets be bridged by a substantial bond, and also that gas piping be connected to other piping systems. The reason for this is that if gas piping should not be in electrical connection with other piping systems in the building, and a connection be established with the electrical wiring, current would flow through the gas meter.

Should the gas meter outlets be open, owing to absence of the meter, there would be a potential of 110 volts across the outlets. This would hardly apply to water meters, unless the meter was absent, as it is almost an impossibility to overheat a pipe or meter containing flowing water with any current generally used in one building.

To safely operate a three-wire system the neutral must remain closed under all possible conditions of service, in order that the receptive devices cannot possibly receive the full voltage between outer wires. Contrary to this, the present rules require both fuses and switches on this neutral wire, the accidental opening of which constitutes a serious fire risk. All protective devices should be required to be placed on the outer wires only, the neutral being run continuously to all points. In addition, the neutral should be permanently grounded at every distributing point, and at each outlet (provided a grounded pipe is available at the outlet), the object being that should the neutral conductor become broken the piping systems would preserve the continuity of the circuit. When it is considered that a ⅜-in. pipe, the smallest used in piping buildings, will safely carry 50 amp., and that the unbalanced load on a system never exceeds 25 per cent. with the most careless balancing, such a pipe would supply the maximum neutral current for 800 lights. Taking into consideration that but a small part of the piping in a building is so small, the danger of overheating it is insignificant compared to the risk from a broken neutral. The pipe joints being all made by screw threads their conductivity could be assumed as being at least equal to that of the pipe itself, so there would be slight danger from this source.

This method should, however, not be construed to permit the use of the piping system as a permanent conductor for the neutral current, the object only being to insure the continuity of the neutral should the normal path become defective. The piping being in multiple with the neutral conductor will, of course, carry a proportion of the current; but, as such piping is capable of safely carrying the total current, there would be no danger of overheating. Further, should a bad joint occur in the piping the resistance would be raised and the current automatically decreased in the pipe and increased in the neutral conductor. Should a bad joint occur in the same section as a broken neutral, there would, of course, be a heating of the joint. In practice this would not be likely to occur. A joint sufficiently bad to offer any appreciable resistance would not be sufficiently tight to hold gas. The chances of such a combination occurring are probably not one in a million, and further, should it

occur there would be a disturbance in pressure at the receptive devices with an unbalanced load, sufficiently great to be investigated at once.

An attempt to attach an electric circuit to piping systems is generally met with opposition from the general public, owing to the impression that a shock may be received from such piping. That such is an impossibility is clearly evident when it is considered that such piping must of necessity be at earth potential, or the same as that of any person standing upon the ground or other earthed conductor.

Having shown the necessity of thoroughly grounding the neutral, it is evident that to require any insulation upon it is clearly a waste of both labor and material. This neutral could be run with bare copper conductors, rigidly secured to the building (but not insulated from it) or pulled in with other wires in conduit systems, all joints and taps being made up solid in preference to any screw-connecting devices. It should be carried direct to all outlets and not to any switch or controlling device. Such switches should be placed on outer wires only, being double-pole on three-wire mains and single-pole on two-wire branches. There are two reasons for this: First, double-pole snap switches frequently become short-circuited from careless handling. Second, any fixture ground can be rendered harmless by opening the outside wire at the switch, which would not be possible were the switch placed on the neutral. This applies to all grounded systems irrespective of whether bare or insulated neutral is used.

Let us next take up the wiring of fixtures, particularly those known as "combination," in which gas and electric arc used on the same fixture. Owing to their generally poor construction these fixtures are not adapted to electric wiring in a permanent form. The practice is to file a notch in the shell of parts slipped over the main supporting stem, the conductors being carried successively through these notches. A slight turning of any of these shells results in grounding the fixture to the wiring.

Should the wire so grounded be an outer there would then be a short-circuit through the permanent ground on the neutral. The practice of placing an insulating joint between the fixture and supporting pipe renders the completion of such a short-circuit impossible, leaving a potential of 110 volts across the members of this joint; and there being no indication that this trouble exists it is allowed to continue. Were there no gas in the piping, the chances of any further trouble would be remote; the gas, however, deposits a film of carbonaceous composition across the insulation on the interior of the joint, permitting a slight leakage of current across the gap. This deposit becoming greater in time, and being further carbonized results in heating of the joint, destroying its gas-retaining qualities. If the heating becomes sufficiently great the gas will become ignited at this point, and the flame, being sucked up between ceiling and floor, spreads beyond control in a surprisingly short time. While this carbonization may require years to reach a dangerous value, the final disruption is very rapid, resulting in a fire without any appreciable warning. The use of these joints constitutes one of the greatest fire risks from electric wiring and should be condemned at once, irrespective of whether the system is grounded or operated clear.

In place of these joints a solid brass coupling should be used, having cast upon it a substantial screw connection for attachment to the neutral conductor of the circuit. The fixture lead connected to neutral or grounded feed could, and preferably should, be of bare copper wire, extending from top of fixture to the sockets. This would leave room in fixture for a heavier insulation on the outside wire, and would also prevent the reversal of any portion of the system in order to throw an accidental ground on the permanently grounded leg of the circuit.

An installation using such a full grounded system would be absolutely free from any danger from crosses with high-potential circuits or from lightning discharges, and could not be operated with any but the intentional ground on the system. With the permission of the Underwriters, such a system would be immediately adapted by all contractors, owing to its being installed for from 10 to 20 per cent. less than under the present rules. One such installation would furnish protection to all the old installations on a network, thus reducing the fire hazard on all the older work.

This full-grounded system being permitted, manufacturers could profitably bring out a line of wire and fittings along the following lines:

Wire.—Conduit wire, fixture wire and flexible cords to be heavy rubber-covered, braided wire, surrounded by an armor of copper ribbon or woven copper gauze, such armor to be used as the grounded conductor of the circuit.

Distributing Cabinets and Switchboards.—For three-wire to have but two buses, with double-pole fuses and switches; two-wire branches to have but one fuse and switch. This would allow practically double the spacing now possible, without increasing the size of the board.

Fixture Sockets.—Outside shell and outer contact to be in electrical connection. Inner contact to make and break, for key sockets, on outer wire binding post, the post being arranged concentrical with outlet pipe, allowing the socket to be screwed on fixture without bending or kinking wire in any way; no connecting post to be placed on outer contact, the fixture arm to be used as the grounded conductor. Bare stem wire, or armor on armored wire, to be connected to fixture body at bottom of fixture; such body preferably being made of brass and having a connecting lug cast upon it, similar to that upon the connecting joint at top of fixture.

The electrical fire risk in any building equipped with an electric installation using wire and fixtures as above would be practically eliminated, any trouble occurring being confined to the interior of the grounded armor for sufficient time to allow of the opening of the protective device, and such device could not be kept closed until the trouble was removed. It being a physical impossibility to remove the permanent grounds on the system, this trouble could not by any possibility be shifted in such a way as to place another fire risk upon the circuit.

The entire working conductor being surrounded by a grounded shield, it would also be impossible to receive any shock from the wires or fixtures, unless this shield was intentionally removed. This would remove one of the great objections of the general public to grounding under the present system of wiring.

Tesla Patent Decision.

Judge Seaman of the United States Circuit Court of the Eastern District of Wisconsin, has handed down a decision on a motion for a preliminary injunction against the National Electric Company, applied for on the grounds that a polyphase synchronous motor manufactured by that company infringed four Tesla patents granted May 1, 1888, two of these being fundamental patents and two on specific means. The injunction was denied on the grounds that previous decisions sustaining Tesla patents did not pass upon the question whether they also covered polyphase synchronous motors.

Judge Seaman discussed the several opinions sustaining Tesla patents, beginning with that of the New England Granite Company case, and concluded that the terms of these only apply to polyphase non-synchronous motors. The sweeping opinion in the New England Granite Company case he considers must be treated as modified by subsequent opinions, and he quotes Judge Brown to the effect that Tesla discovery was not broadly the use of alternating currents of different phase with an ultimate object of rotating any shaft. No case involving the use of a motor operated in synchronism has been brought to final hearing, though such use constantly appeared, while litigation was vigorously prosecuted against non-synchronous infringements—one instance being that of the continuous manufacture of synchronous motors by a defendant, who was under injunction against infringement by a non-synchronous motor in suit and this without interference until lately. The question of infringement in the present case under the fundamental facts depends upon the scope of the invention and involves a broader construction than was involved in any other prior cases, and consequently the court denied the motion for preliminary injunction.

Wireless Telegraphy in Alaska.

A dispatch from Tacoma, Wash., states that wireless telegraphy between Nome and St. Michael has practically failed, the distance between the two points being too great for successful transmission during winter weather. It is suggested that the government establish two more stations in order to accomplish the desired result. Stations have already been established at Port Safety, near Nome, and St. Michael, at a cost to the government of $6,000. The distance across Norton Sound between the two existing stations is about 125 miles.

Efficiency Test of 1250-K.W. Steam Turbine for Interborough Company, New York City.

By A. M. Mattice.

During the present period of rapid introduction of the steam turbine, it is of especial interest to observe its economic performance under conditions of test approximating those of future daily service. Data of definite and dependable character has, in many cases, been of such noticeable scarcity that results of carefully-conducted tests should merit special attention and credence. The following presents the most important results of a series of performance tests conducted at the builder's works upon a 1,250-kw Westinghouse-Parsons steam turbine-generating unit, the first of the three units selected by the Interborough Rapid Transit Company for the illumination of the New York Subway. The tests were executed on October 12-15, 1903. The calibration of the various instruments and the computation involved were all verified by Julian Kennedy, consulting engineer, Pittsburg.

CONSTRUCTION.

Turbine.—The turbine is of the two-cylinder, multiple-expansion, parallel-flow type, arranged in tandem compound and direct-connected through a flexible mechanical coupling to the generator. The three sections of the unit are mounted upon a single bedplate, thus making the unit self-contained. Both turbine cylinders are covered with non-conducting material secured in place by sheet-steel lagging. In the pipe connection between the outlet of the high-pressure cylinder and the inlet of the low-pressure is inserted a separator. The condensation collecting at this point is normally removed by a trap, but during the tests the water was collected in a vessel of known cubical contests fitted with a water gauge. After recording the amount separated the water was returned to the exhaust main and was subsequently included in the total steam consumption.

The turbine is governed by a fly-ball governor of great sensitiveness, positively driven from the end of the shaft. Steam is admitted in short puffs at intervals of about 2½ seconds, the duration of each puff being controlled by the governor mechanism. The admission steam is thus not throttled in proportion to the load, but is always admitted at approximately boiler pressure, thus securing the highest efficiency from the temperature range available. The governor spring tension is adjustable by hand during operation, so that the speed of the turbine and consequently the load (if operating in parallel with another unit) may be readily controlled. In addition to the regular governor, the turbine has an overspeed safety governor which operates with high-pressure steam an automatic quick-closing throttle valve inserted in the main steam pipe. This governor is positively driven from the turbine shaft and may be adjusted to operate at any predetermined overspeed.

Overload capacity up to 50 per cent. of normal rating is secured by a hand-operated by-pass valve admitting high-pressure steam to the second stage of the turbine. The effect of the by-pass is well shown in the economy curves.

The bearings of the turbine unit are continuously and automatically lubricated by an oil-circulating system operated by a small plunger pump driven from the turbine shaft. This pump delivers oil under a head of about 18 inches. This gravity head is sufficient to thoroughly flush the bearings, which are of the flexible shell construction and of sufficient size to avoid the use of any oil under heavy pressure. The oil is returned to a reservoir in the bedplate and is cooled on its way to the bearings in a copper coil surrounded by cold water.

Generator.—The turbo-generator is of the revolving field type delivering three-phase, 60-cycle current directly to the distributing system at a pressure of 11,000 volts. The unit operates at a speed of 1,200 r.p.m., thus requiring a six-pole field. The rated capacity at full load is 1,250 kw with 25 per cent. continuous and 50 per cent. intermittent overload capacity. As efficiency tests had been periodically made upon the generator, no detailed tests were made at this time, but the entire unit was tested as a whole, from steam input to electric output.

Fig. 1.—General View of 1,250-kw Turbo-Generator.

Contract Guarantees.—The contract provisions covering the efficiency of the unit were as follows: With 175 pounds steam pressure at the throttle, 27 inches vacuum, measured by mercury column and referred to a 30-inch barometer, the consumption of steam at various loads should not exceed the following:

	Dry Saturated Steam.	Steam Superheated 75° Fahr.				
Full rated load	15.7	13.8	lbs.	per	e.h.p.	hour.
¾ "	16.6	14.6	"	"	"	"
½ "	18.2	16.2	"	"	"	"
¼ "	23.2	20.8	"	"	"	"

Method of Test.—After being assembled complete in the erecting shop, the turbo unit was transferred by traveling cranes to one of the testing foundations. As no foundation bolts are used no further preparation was necessary to operate the turbine than to connect up to the steam and the 36-inch exhaust pipes, each of which has outlets at the various testing pits.

During the superheated-steam tests, the steam was superheated by an independent gas-fired superheater, which forms part of the permanent testing outfit in the Westinghouse turbine shop.

The exhaust steam was condensed in an Alberger counter-current

surface condenser, provided with separate dry and wet air pumps, the former being of the two-stage type with Corliss gear. This condenser is one of several employed only for testing purposes. It was tested for leakage immediately before and after the tests, and the correction applied to the observed steam consumption of the turbine.

At the conclusion of each test the water in the drainage or hot

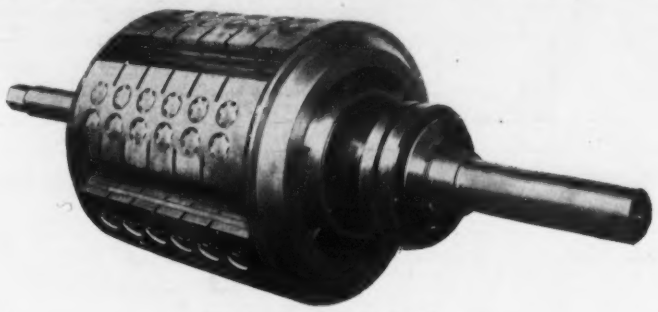


FIG. 2.—ROTATING FIELD.

well of the condenser was left at the same height as at the beginning. Even a considerable error in this respect could have no material effect on the results. The hot well is 36 inches in diameter, and, assuming the temperature of the water to be 110° F., a depth of one inch of water would be equivalent to 36.5 pounds in weight. In the case of a turbine developing 1,000 ehp, for instance, at a consumption of 14 pounds of steam per ehp hour, the total steam used in one hour would be 14,000 pounds. If, then, an error of one inch should be made in the level of the water in the well after a one-hour test, the error would amount to only 35.5/14000, or about one-quarter of one per cent.

The tests were conducted in the same manner as are the regular commercial tests of all turbines built in the Westinghouse shops. The number of tests was, however, greater than is usually called for, and extreme accuracy was secured by the duplication of all instruments. Throughout the several tests all readings, including weighings of condensed steam, were made at intervals of five minutes.

Measurement of Load.—The electrical load was applied by means of a large adjustable water rheostat, which also forms part of the regular testing outfit. As the generator pressure of 11,000 volts might prove a source of danger to the attendants if passed directly into a water rheostat, the voltage was reduced by step-down transformers to about 550 volts. All electrical measurements were, however, made between the generator and the transformers.

Voltage was measured by two voltmeters, one being used as a check on the other, the pressure on the instruments being reduced by potential transformers having a ratio of 100 to 1. Each of these voltmeters was arranged so that it could be plugged in between any of the three terminals of the generator.

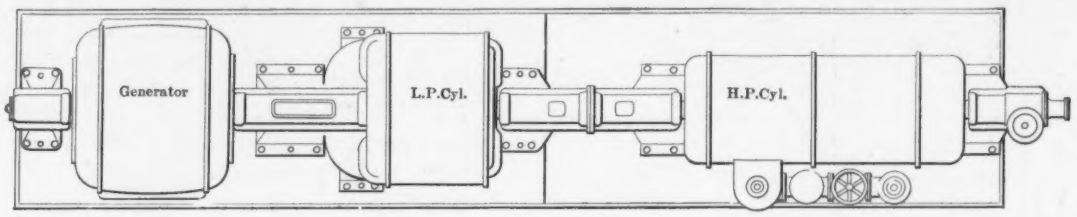
Current was measured by a duplicate set of long-scale, dead-beat ammeters. In each of the three phases were inserted two-current transformers, in series, each connected to a low-voltage ammeter. In addition to the two ammeters in each phase, a carefully calibrated Siemens dynamometer was plugged into the various phases at each reading. The dynamometer readings alone were used in the case of the lightest loads, by reason of the difficulty in reading the ammeters with sufficient accuracy for the purposes of the test. At each reading three successive observations were taken.

All the electrical instruments, including the potential and current transformers, were carefully calibrated in the Westinghouse Electric & Manufacturing Company's standardizing laboratory immediately before and immediately after the tests.

Pressures, Temperatures and Speed.—Steam pressure at the throttle was observed by a duplicate set of gauges and vacuum by a mercury column connected to the turbine exhaust.

Temperatures of steam were measured by duplicate thermometers inserted in thermometer cups in the steam pipe. During the saturated-steam tests two throttling calorimeters were used and the quality was maintained as near as possible to that of dry saturated steam by drying it in the superheat just enough to evaporate the moisture which had condensed in the long run of piping leading from the boilers.

The speed of the turbine was ascertained from the speed of the oil



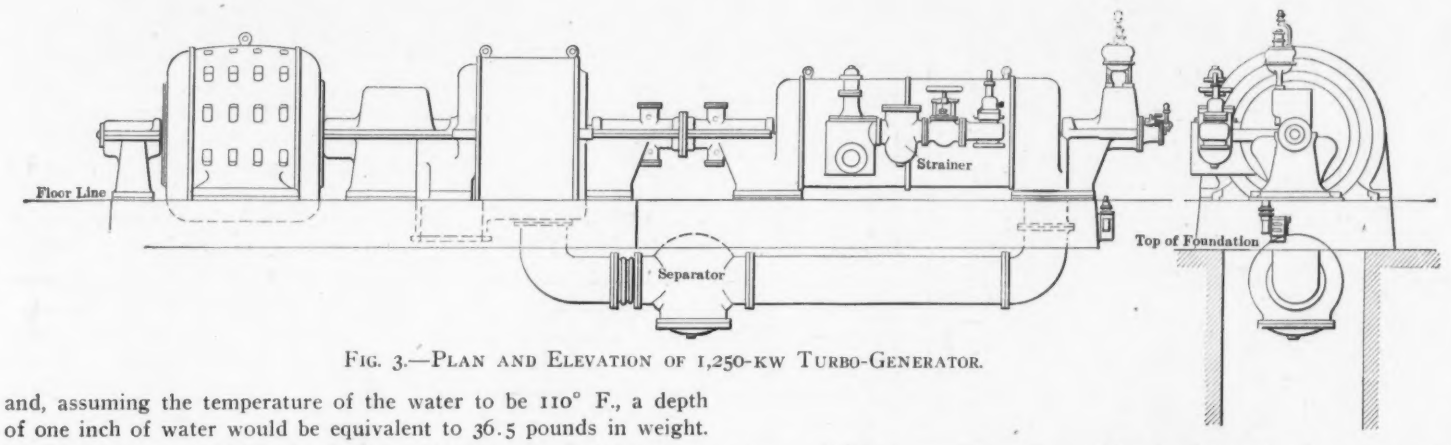


FIG. 3.—PLAN AND ELEVATION OF 1,250-KW TURBO-GENERATOR.

pump, which is geared to the turbine in the ratio of 31 to 4. A tachometer was used to detect sudden small variations of speed, if such should occur, as well as to show the speed regulation when the

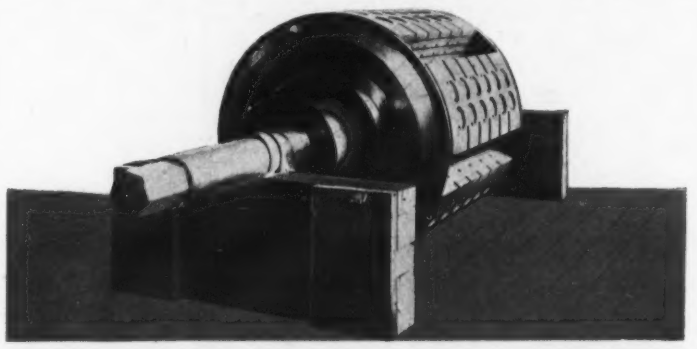


FIG. 4.—ROTATING FIELD.

load was suddenly increased and decreased. The records of speed, however, did not enter as factors in the measurement of power, which was ascertained entirely by observations of the electrical output.

Regulation Test of Speed.—At the conclusion of the economy tests, a load of 1,309 kw was thrown off by opening the exciter circuit, with a resulting increase of 2 per cent. in speed. A load of 1,342 kw

was then thrown on and a speed variation of 2.2 per cent. in the opposite direction was shown. This load on being thrown off showed a speed variation of 2.07 per cent.

Test of Safety Stop.—The speed of the turbine was increased by holding down the main governor lever, thus preventing the governor

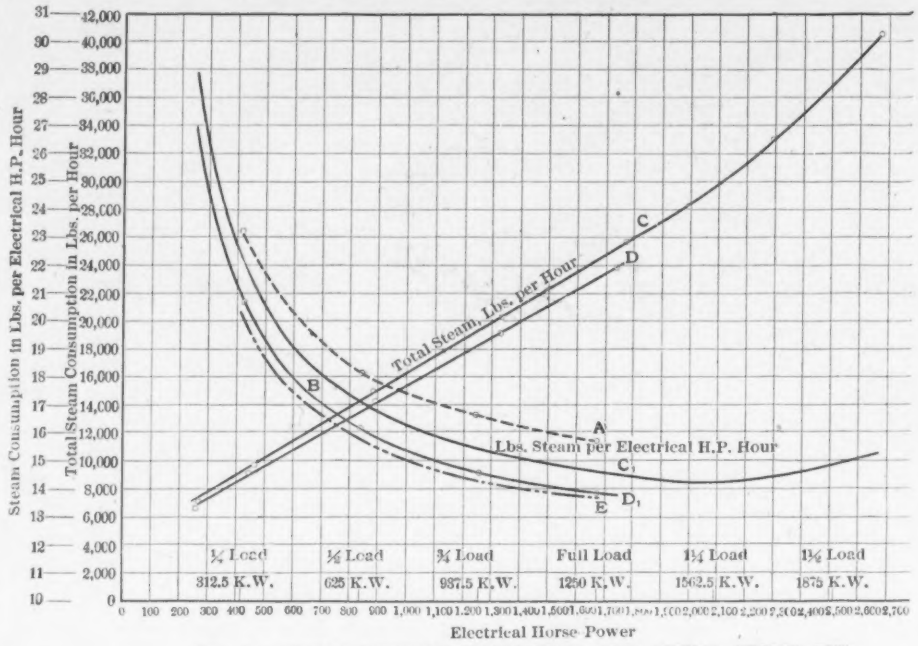


FIG. 5.—CURVES SHOWING GUARANTEED AND ACTUAL STEAM CONSUMPTION.

from controlling the speed. At 1,372 r.p.m., or 14.35 per cent. above normal speed, the safety stop operated and brought the turbine to rest.

Results of Economy Test.—The results of the tests for steam consumption are shown by the accompanying table. The tests from light loads to full rated load with 27 inches vacuum were made to determine the fulfilment of the contract guarantees, but the overload tests and those on 28 inches vacuum were made for general information. The tests were limited in scope and number by the necessity of removing the turbine from the testing floor to make room for other commercial work.

The tabulated results are shown graphically by the accompanying curves, Figs. 5 and 6. Fig. 1 is a comparison of the guaranteed

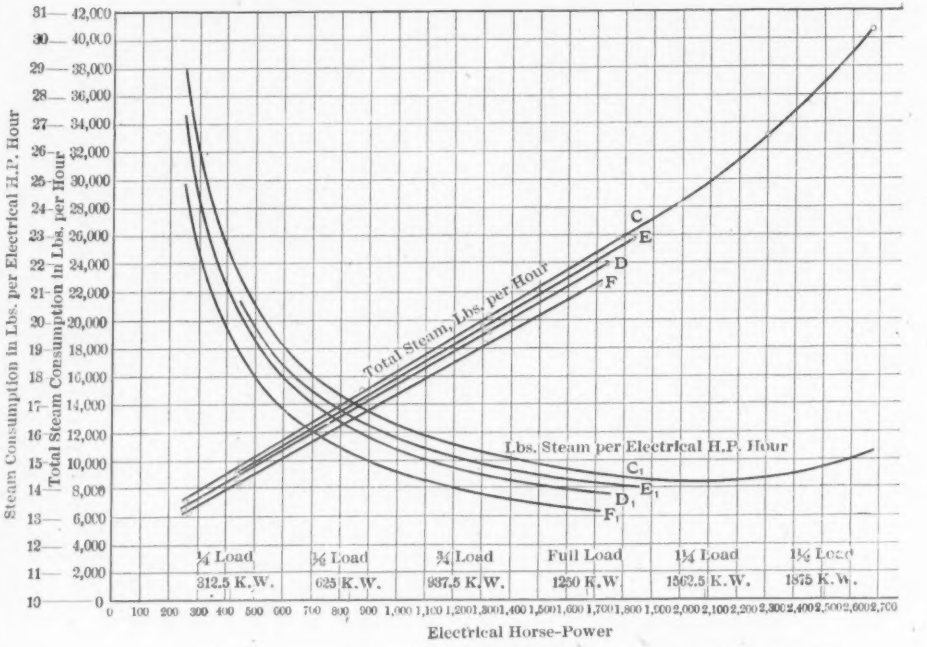


FIG. 6.—CURVES SHOWING STEAM CONSUMPTION AT VARIOUS VACUA, WITH AND WITHOUT SUPERHEAT.

economies and those actually obtained. It will be seen that with saturated steam the results were considerably better than the guarantees, the difference at full load being about 7 per cent. of the guaranteed steam consumption. This economy was obtained, more-

TEST DATA

Test number.	Dry Saturated Steam and 27" Vacuum.								Dry Saturated Steam and 28" Vacuum.						75° F. Superheat and 27" Vacuum.						75° F. Superheat and 28" Vacuum.					
	20	10	9	8	6	22	23	24	21	7	5	18	17	13	19	16	15	14	12	4	3	2	1	11
Steam pressure outside of throttle, lbs. per square inch, per gauge	150.3	151.4	146.8	146.5	147.1	148.0	144.5	141.8	151.0	146.8	146.1	151.8	150.8	147.6	151.8	151.9	150.0	147.7	146.3	151.2	151.2	151.2	151.2	146.0
Vacuum at outlet of L. P. cylinder, referred to 30" mercurial barometer	27.08"	27.11"	27.1"	27.11"	27.11"	27.05"	27.05"	26.79"	28.05"	28.1"	28.08"	28.05"	28.05"	28.1"	27.15"	27.07"	27.15"	27.1"	27.1"	28.05"	28.05"	28.05"	28.05"	28.1"
Superheat, degrees Fahrenheit	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	76.6	77.2	77.0	76.15	76.0	.....	.....	.....	.....	.....
Quality of steam	0.999	0.999	0.999	1.000	0.999	.....	0.999	0.999	0.999	1.000	1.000	0.999	0.999	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Revolutions per minute	1201.0	1201.2	1199.4	1197.4	1195.6	1201.0	1200.0	1197.4	1201.0	1212.9	1209.0	1205.1	1200.6	1198.0	1200.6	1197.4	1217.0	1214.4	1203.8	1199.4	1201.0	1201.0	1201.0	1201.0
Load in kilowatts	196.95	342.73	655.98	989.53	1321.46	1489.4	1713.5	1988.9	191.0	333.55	664.67	986.23	1293.9	972.0	1363.95	198.4	333.15	977.64	1274.2	1713.5	1988.9	191.0	333.55	664.67
Load in electrical horse-power	264.0	459.42	879.33	1326.5	1771.4	1996.5	2297.1	2666.0	256.0	447.1	891.0	1322.04	1734.9	448.74	1303.0	1838.3	266.1	446.6	1310.5	1708.0	2297.1	2666.0	256.0	447.1
Total weight of steam consumed per hour, lbs.	7155.0	9732.0	15074.0	20254.0	25712.0	28208.0	33036.0	40547.0	6734.0	9170.0	14181.0	19108.0	23903.0	9295.0	19334.0	25639.0	6300.0	8420.0	18180.0	22504.0	33036.0	40547.0	6734.0	9170.0
Lbs. steam per kilowatt-hour	36.32	28.4	22.98	20.46	19.47	18.95	19.28	20.39	35.25	27.58	21.33	19.39	18.48	27.78	19.99	18.79	31.76	25.39	18.59	17.66	19.28	20.39	35.25	27.58
Lbs. steam per electrical H.P.-hour	27.08	21.18	17.14	15.27	14.52	14.13	14.38	15.21	26.3	20.51	15.9	14.45	13.78	20.71	14.91	14.02	23.68	18.86	13.87	13.17	14.38	15.21	26.3	20.51
Load in terms of nominal full rated load	0.157	0.276	0.525	0.790	1.060	1.190	1.370	1.590	0.153	0.267	0.531	0.790	1.038	0.268	0.778	1.091	0.159	0.266	0.780	1.020	1.370	1.590	0.153	0.267
Lbs. steam per equivalent I.H.P. of a reciprocating engine, assuming 90% combined efficiency of engine and generator, with losses constant at all loads	15.89	15.08	14.14	13.39	13.14	12.93	13.30	14.21	15.22	14.48	13.16	12.66	12.44	14.64	12.99	12.73	13.93	13.30	12.15	11.89	13.30	14.21	15.22	14.48
Ditto, assuming 85% combined efficiency	12.78	12.89	12.82	12.49	12.44	12.31	12.74	13.69	12.21	12.34	11.94	11.81	11.77	12.48	12.09	12.07	11.22	11.33	11.31	11.23	12.74	13.69	12.21	12.34

DEDUCTIONS FROM THE ABOVE TEST RESULTS.

over, with steam of only 147 pounds pressure, instead of under the contract condition of 175 pounds pressure, as the higher pressure was not available.

With superheated steam at the same pressure, the tests showed an economy so close to the guaranteed results that the difference is hardly perceptible in the curves. An additional curve (*E*) has been plotted to show the probable steam consumption which would have been obtained if the contract steam pressure of 175 pounds has been available, this curve having been computed on the basis of tests on other turbines at various pressures.

Fig. 7 shows these results, with the omission of the guarantee curves and the addition of the curves of steam consumption under

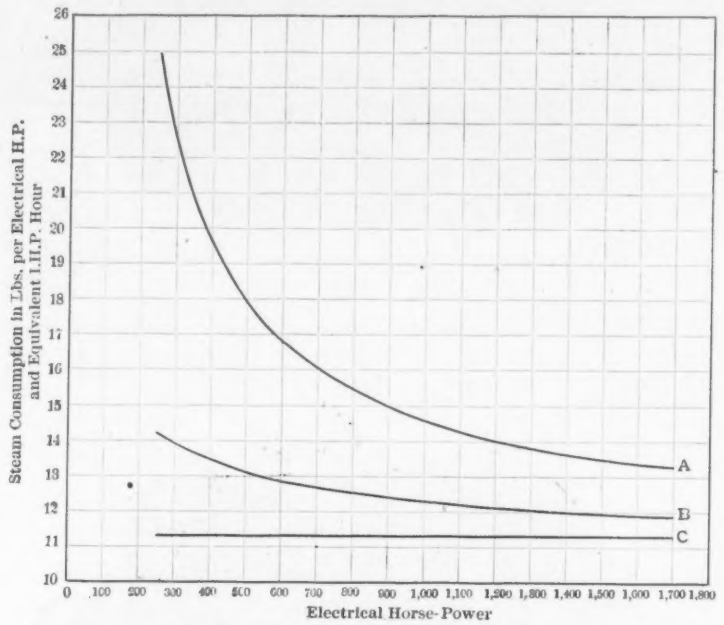


FIG. 7.—CURVES OF ECONOMY WITH AND WITHOUT SUPERHEAT, AT DIFFERENT VACUA.

28-inch vacuum, thus giving a comparison of the economy with and without superheat, and with different vacuua.

An important result shown by curve *C*, Fig. 2, is the effect of the by-pass on overloads. The material difference between the curvature of *C* and the by-pass curves published heretofore lies in the method of manipulation. If, when the turbine reaches full load, the by-pass is opened full, the water rate is suddenly increased by a small amount. As the load is further increased, the economy gradually improves and at the limit of the turbine capacity the full load water rate has nearly been reached. In the tests represented by curve *C* the operation was reversed, the by-pass valve being opened by hand at the various loads only sufficient to maintain normal running speed. Thus the by-pass steam is approximately proportional to the overload upon the turbine. The rise in the curve is marked only on heavy overloads, when the valve is nearly open and the best economy of the turbine is thus maintained throughout moderate overloads.

The curve *C* thus presents a striking similarity to the economy curve of a piston engine, except that the rise on under and overloads is less marked; or, in other words, the economy is greater.

Furthermore, a piston engine with the usual cut-off gear reaches its best economy at about three-fourths full load rating, the steam consumption being considerably greater at full load and increasing rapidly on overloads. The turbine, however, preserves its best economy, occurring at about full load, through a considerable range of overload, with the result that operation during peak loads on the station may be accomplished without the loss of efficiency occurring in engine operation.

COMPARISON WITH RECIPROCATING ENGINE.

From the curves it might at first appear that the steam consumption of the turbine is high at light loads, as compared with that of a reciprocating engine of corresponding size. Such an idea might naturally arise from the fact that it is customary to think of engine economy as steam consumption per indicated horse-power rather than per brake or electrical horse-power. The indicator does not, however, reveal engine or generator losses. In the turbine tests here described both are included in the figures on steam consumption.

In order to bring this point out more clearly, take for instance the results obtained under 75° superheat and 28 inches vacuum, shown in curve *A*, Fig. 7. The steam consumption at full load is 13.25 pounds, and at one-quarter load 19.25 pounds per ehp. If, for comparison, a combined efficiency of 90 per cent. be assumed for the piston engine and direct-connected generator, the steam consumption of the turbine per equivalent ihp would be 11.9 pounds at full load, which rivals the best modern steam engine performance.

The most marked economy of the turbine, however, in comparison with the engine, occurs at light loads. Assume now a reciprocating engine unit in which the total losses are constant at all loads, and also that the steam consumption per ihp is constant at all loads. Will the turbine meet these assumptions? And, under these conditions of constant losses and water rate, what will be the relation of water rate to output? Manifestly the total losses of the hypothetical engine, which amounted to 10 per cent. of the indicated work at full load, will be 20 per cent. at half load and 40 per cent. at quarter load. The corresponding efficiency will, then, be 90 per cent. at full load, 80 per cent. at half load and 60 per cent. at quarter load. It is safe to say that the extent of this lost power at light loads in the engine is not generally appreciated.

Considering further the assumptions, it should be borne in mind that they are greatly in favor of the reciprocating engine and do not represent actual performance. Firstly, the usual combined efficiency of a high-grade engine unit is more nearly 85 per cent. than 90 per cent., and even 85 per cent. is attained by few makes. Secondly, the indicated water rate of the engine is far from constant, whereas experience and data show that the water rate increases on both under and overloads. A test made by Prof. Jacobus upon a compound four-valve engine fitted with reheating receiver and steam jackets illustrates this point. The engine showed maximnm economy at about 700 ihp; at half the load the water rate increased 24 per cent. and at 1,000 maximum ihp nearly 7 per cent.

The assumption of constant losses is not far from correct for well-designed machines. Brake tests show that friction losses at heavy loads are but slightly greater due to the greater pressures on the various parts. Generator losses are likewise nearly constant. In the generator under test, the increase in loss from full to ¼ load was less than ½ per cent. of the rated capacity.

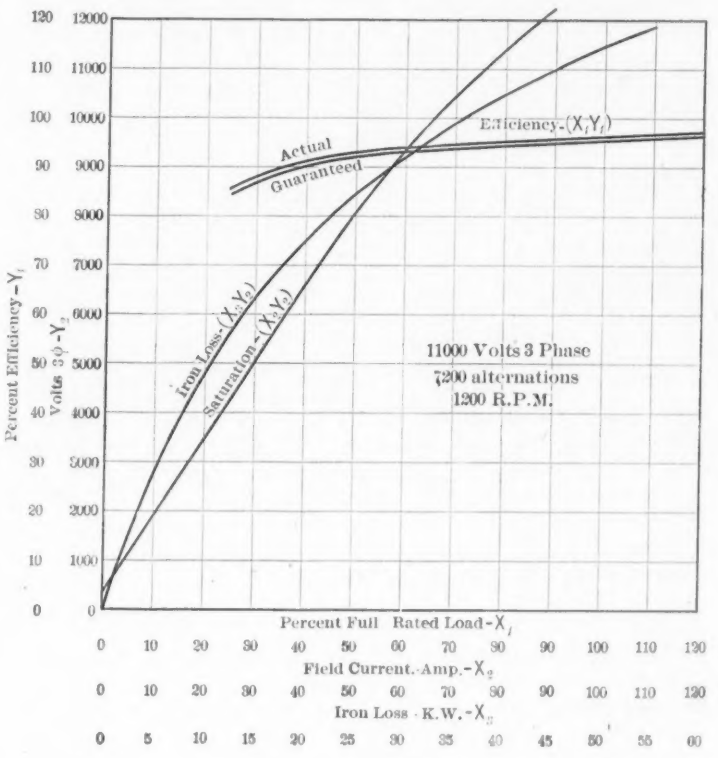


FIG. 8.—CURVES OF SHOP TEST OF 1,250-KW TURBO-GENERATOR.

Compare now engine performance with that of the turbine here described. Curve *A*, Fig. 7, shows the actual steam consumption per ehp hour. Curve *B* shows the consumption per equivalent ihp, under the assumption of constant losses and water rate, and of 90 per cent. combined efficiency at full loads. The increase in steam

consumption at half load is but 4.6 per cent. and at overload the consumption decreases rather than increases.

Following out this method with an assumed total efficiency of 85 per cent., instead of 90 per cent., results are obtained shown in curve *C*. The indicated water rate of the turbine is 11.26 pounds and it is constant at all loads, thus confirming the original assumptions. In order to meet these results a piston engine must not exceed a water rate of 11.26 pounds per ihp at full load and must maintain this economy throughout its range of load.

The superior efficiency of the turbine finds explanation in the fact that expansion is approximately adiabatic; that the cylinder remains constantly at the temperature of the working steam and is not alternately heated and cooled as in the piston engine. Although mechanical losses in the engine are so nearly constant, the thermodynamic losses are so pronounced, particularly at fractional loads, as to preclude comparison with the steam turbine.

GENERATOR TESTS.

Individual tests on the turbo-generator were made in the Westinghouse Electric & Manufacturing Company's shops previous to the combined tests above described. These shop tests included the measurement of iron loss, determination of the saturation curve and short-circuit tests, and preliminary temperature runs. The characteristics of the generator are as follows: 1,250 kw, three-phase, 11,000 volts, 60 cycles, the full-load current being 65.6 amp. per terminal. Separate excitation of the generators is employed.

Results from some of the tests are shown graphically in Fig. 8. The actual efficiencies obtained were as follows:

	Actual.	Guaranteed.
1¼ full load	96.5%	96%
Full load	96	95.5
¾ "	95	94.25
½ "	92.7	92
¼ "	86	85

Following the customary practice, these efficiencies are calculated from measured electrical and magnetic losses, bearing friction and windage not being included. The short-circuit current of the generator is approximately 3¼ times the full-load current. The generator was run on open circuit for 11¾ hours at 12,150 volts, with full excitation. Under these conditions the maximum observed rise in temperature in stationary iron was 26.7° C. by thermometer, and the corresponding rise in the temperature of the field 16.7° C. With full load thrown off, the rise in voltage as estimated from the short-circuit test and armature resistance is under 6 per cent.

The Patent Office in Germany

The *Frankfurter Zeitung* of December 6, 1903, says: "The German Patent Office is overwhelmed with work. The number of applications for patents is still increasing. It was 27,565 in 1902 and will be about 29,000 in 1903 and 30,000 in 1904. Trade-mark applications for the last few years show an increase also. They were 9,924 in 1901, 11,168 in 1902, and will be about 12,000 in 1903. A further increase for 1904 is expected. Of the present five directors of the Patent Office four are lawyers and one a technologist.

"Another director is to be added. His duties will be principally to assist the president of the board of directors with reference to the technical personnel of the office, as well as to the general technical matters of the office, which, on account of the close relations of the patent office to the industries, are constantly becoming more important.

"Seventy-two technical clerks are at present employed in the examination of patent applications. In consequence of the great work involved in the examination of the steadily-increasing material, this force has become inadequate. An increase of nine technical clerks is necessary.

"In the two divisions for trade-marks there are at present, in addition to the two chairmen, five law and five technical experts and five assistant law referees. The necessity has arisen to increase the lawful organization of the division through additional members and cut off some of the assistants who can only take the place of a member to a limited degree. For 1904 two new lawyer members are required."

The Lamme Single-Phase Railway Motor.

We are enabled to present herewith illustrations and a description in detail of the Westinghouse straight-series, single-phase railway motor, which formed the subject of the English patent noticed in these columns last week.

The motor shown has a nominal rating of 125 hp on the basis of a one-hour run at full load with rise of temperature not exceeding

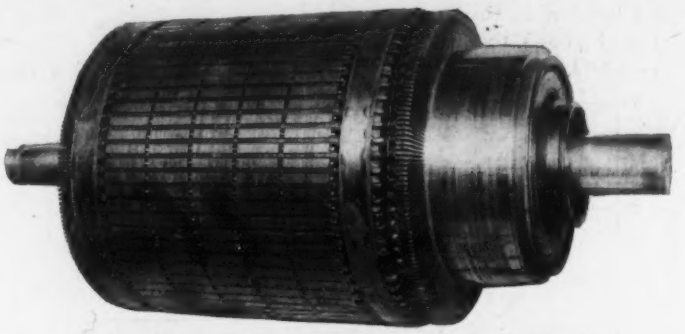


FIG. 1.—ARMATURE WITH COMMUTATOR AND BEARINGS.

75° C. Mechanically, it follows the general lines now regarded as standard for direct-current railway motors. The principal features peculiar to the new type are found in the construction of the magnetic field and in the winding of the armature and field coils. It is

FIG. 2.—MOTOR, FRONT VIEW.

scarcely necessary to say that the motor is series-wound and of the commutator type.

The field frame consists of a cylindrical shell of cast steel, to which are bolted solid end brackets of the same material. These end

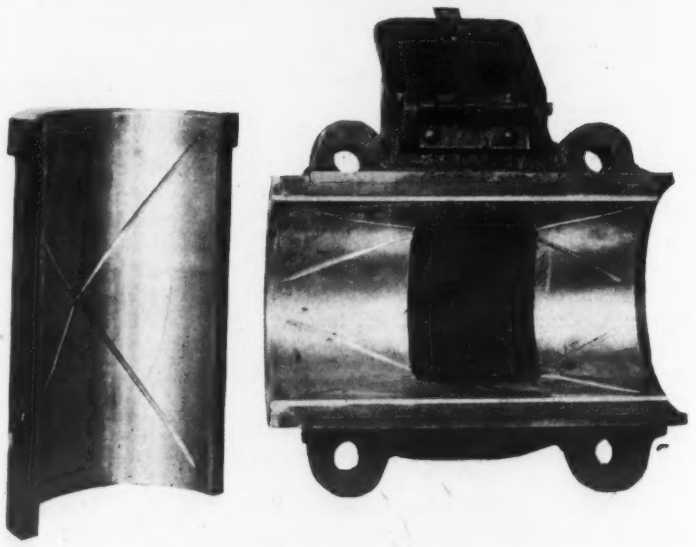


FIG. 3.—AXLE BEARINGS, BABBIT-LINED.

brackets contain supports for the armature bearings. The upper caps of the axle bearings are cast solid with the frame. The lower caps are rigidly held in place by heavy bolts. The axle bearings con-

sist of cast-iron shells lined with babbit and divided into two parts. Solid shells, also babbit-lined, are used for the armature bearings. The bearing boxes are large and are packed with waste and oil lubrication is used throughout. The extensions which carry the axle bearings are especially strong and heavy. There is a large opening in the upper frame which permits access to commutator and brushes, and numerous hand holes are provided both in the end brackets and bottom of the motor. Lugs for "nose" suspension and support of the gear case are cast solid with the frame.

The field core is made up of circular punchings of soft laminated steel. The poles are rectangular in section and project inward, thus forming a magnetic circuit which is wholly laminated and without break from pole face to pole face. As the armature core is correspondingly constructed there is no mechanical joint in the whole magnetic circuit. The construction of the motor is in general the same as that which is used for ordinary alternating-current induction motors.

The field coils are wound with copper strap bent on edge, and held firmly in place by adjustable hangers of improved design. The

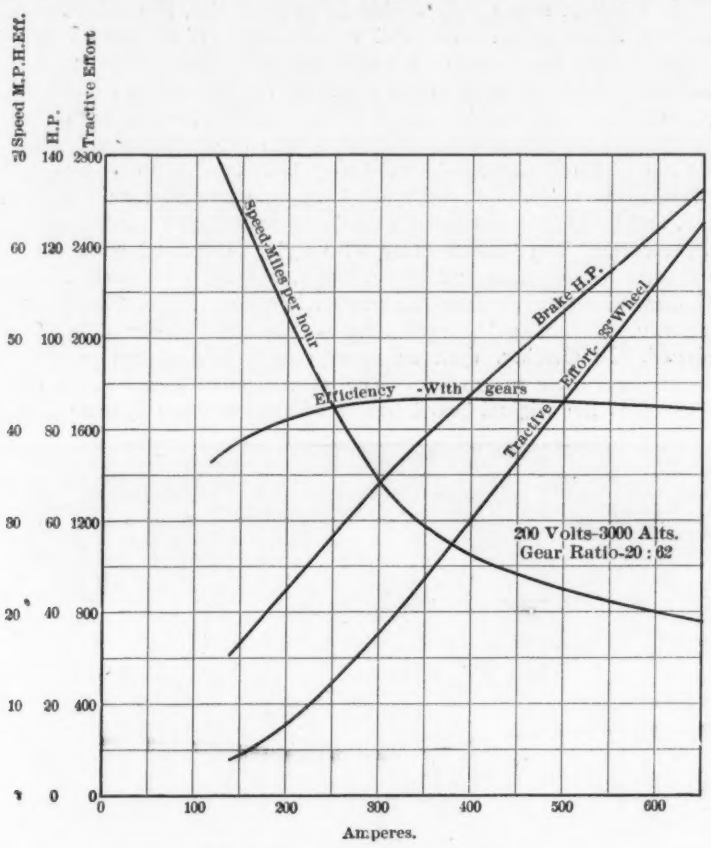


FIG. 4.—PERFORMANCE CURVES.

coils are all connected in series. Brush holders of the sliding shunt type are supported inside the end bracket, and carbon brushes are used.

The armature is of the slotted drum type with machine-formed coils. The core is composed of laminated punchings of soft steel built up upon a spider, with numerous ventilating spaces provided to permit air to circulate through the core and between core and coils. The slots are of the open type. The coils are made of copper strap without joint, and are held in place by retaining wedges of hard fibre, there being no band wires over the core. The winding is of the multiple type. The commutator is built up of cold-rolled copper segments with long necks.

The motor is wound for 225 volts and a frequency of 25 cycles or lower. Its general performance is shown by the curves in Fig. 4. These curves indicate the similarity in performance to the direct-current, series-wound railway motors now standard. Though designed primarily for operation on an alternating-current, single-phase circuit, the motor may also be operated by direct current. For this purpose a modification of the standard controlling apparatus is required.

The motor here described has been designated No. 91. A complete line of motors of this type has been designed by the Westinghouse Electric & Manufacturing Company for application to railway service of any class.

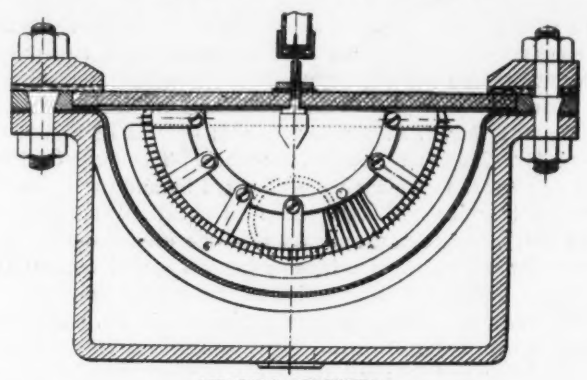
Recent Electrochemical Developments.

STERILIZING WATER BY OZONE.

While in this country that class of electrochemical processes in which chemical effects are produced by electric discharges has been brought into prominence by Bradley's celebrated work on the fixation of nitrogen from air, many inventors abroad have lent their energies to the development of the kindred process of ozonizing air and using the ozone for sterilizing water. On a commercial scale this method seems to have first been applied somewhat over 10 years ago in the city of Hamburg, where, during an epidemic of cholera morbus, smaller ozonizing and water sterilizing apparatus were installed in private residences, which were lighted electrically so that current was available for the other purpose. On a much larger scale such apparatus have been installed more recently in various cities, notably in Diesbaden, where the municipal water works are working in conjunction with an ozonizing plant. In view of the condition of the drinking water in many American cities, it is somewhat singular that such methods have not yet found any introduction in the United States on a commercial scale.

There have been devised quite a number of different ozonizers which vary greatly in design and especially in the nature of the dielectrics. While the Siemens and Halske apparatus, which appears to have found the most extended industrial application, uses glass dielectrics, others do not and are said to work satisfactorily. The use of glass is, of course, always a source of danger since it is liable to break. There is also a great variety in the design of sterilization towers. In general, however, the ozone is introduced at the bottom of the tower, which is filled with stone or sand, while the water passes downwards and thus comes into contact with the rising stream of ozonized air.

A patent granted on February 9 to Mr. A. J. Wessels, of Paris, France, relates to an ozonizer which is similar in design to that of Tindal. As shown in the adjoining illustration, a semi-cylindrical trough of metal, which forms one electrode, is placed inside a jacket of enamel. The intermediate space is filled with water for cooling purposes, since the process of ozonizing air requires that the tem-



WESSELS OZONIZER.

perature should not rise above a certain point. A glass cover forms the top of the apparatus and supports a series of metallic points, as shown in the illustration. The electric discharges take place between these points and the semi-cylindrical metallic trough below. The stream of air to be ozonized passes in a direction perpendicular to the cross-section shown in the illustration. The air is passed successively through several ozonizers, between which special cooling devices are inserted to reduce the temperature of the ozonized air, which goes from one ozonizer to the next one.

MISCELLANEOUS.

A patent granted to Mr. O. Kartzmark, of Brooklyn, relates to details of mechanical construction of an apparatus for purifying liquids. Nothing is said concerning the electrodes to be used nor concerning the chemistry of the process, but it appears that like other inventors he intends to use anodes of such a nature that the anodic products of the current cause subsequent coagulation. In the apparatus described a receptacle with a series of parallel electrodes is placed in a larger vessel. The liquid is passed upwards between the electrodes and flows over the edges of the inner receptacle to the outer vessel.

A patent granted to Mr. A. J. Marschall, of Little Falls, N. Y., refers to the composition of an "exciting liquid" for use in a dry cell. It is a strong solution of zinc chloride with a small addition of ammonium chloride.

New Installation at City of South Norwalk Electric Works.

By A. E. Winchester.

THERE has just been completed an interesting installation, known as "The Enlargement of 1903," at the above plant, which has always been notable for its success. This enlargement is the third one required within five years to meet the increasing demands upon the plant, and is very gratifying to the advocates of municipal ownership. The original plant installed by the city was completed in 1892, at a cost of $22,500, and was used exclusively for street lighting. The movement in favor of the municipal plant was brought about by the poor service for street lighting, supplied by the local company. They supplied the city with 800-cp street lamps, and the demand was for something better. As the company did not respond to the demand, the city plant was built.

The construction and management have been carried on under

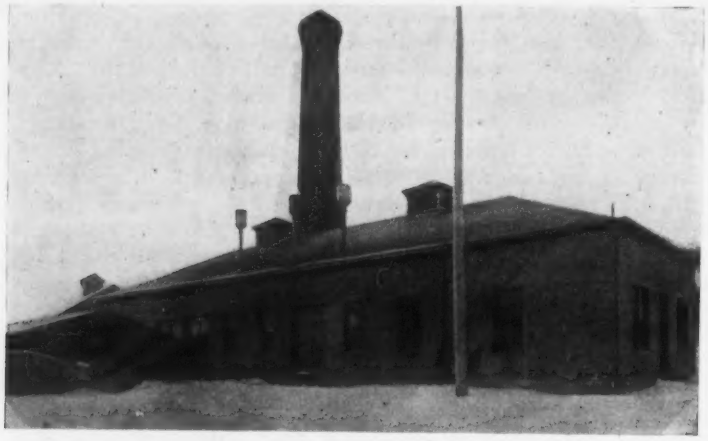


FIG. 1.—SOUTH NORWALK STATION.

a Board of Electrical Commissioners, consisting of three members, who were elected by the people from the establishment of the plant in 1892, until 1898, when the arrangement was made to appoint them by the council, which plan is still maintained. The present commissioners are: Mr. J. A. Volk, president; Col. Leslie Smith, treasurer, and Mr. Charles N. Smith, secretary. The plans and specifications of the original plant were prepared by and the construction was executed under the supervision of A. E. Winchester, formerly of the Edison Company, who was one of the electrical commissioners for ten years. He became general superintendent of the plant in 1897, and holds this position at the present time. The first installation consisted of a building containing a boiler, stack, engine, two 60-light arc dynamos, with the necessary switchboard apurtenances, pole line and 86 arc lights. Up to the time of the present enlargement all of the apparatus with the exception of the iron stack have remained in service.

In 1895 the question of embarking in commercial lighting was agitated, and after two years' investigation an appropriation for this purpose of $20,000 was made by the people in 1897. This money enabled the plant to establish a complete commercial service on a paying basis. The growth of the new business was so rapid that a year later it became apparent that it would be necessary to double the output of the commercial branch, and in May, 1900, $17,500 additional appropriation was made available to meet the demand. About this time the Connecticut Lighting & Power Company, which already had instituted suits against the city for alleged damages, etc., on account of the plant, also attempted to prevent the city from supplying commercial lighting or enlarging its plant. An injunction was obtained which was to have been argued before the Supreme Court, but after considerable legal cross fire, which did not stop operation or enlargement, all suits were withdrawn, leaving the city with a clear field to continue the operation of its plant. The city plant does not have a monopoly of the business, as there is a keen though harmonious competition between it and the local company which supplies commercial lighting by means of both electricity and gas; though it confines its energies to promoting the use of the latter. The streets are lighted exclusively by the city plant, which also now supplies over 90 per cent. of the commercial electric lighting and power.

The finances of the municipal plant are managed in a manner similar to that of a private enterprise, the city paying a fixed annual rate of $60 per annum each for the street lamps, and the customers are supplied at 10 cents per kw-hour for lighting and 5 cents for power, as maximum charges, with a sliding scale of prices proportioned to the service used.

Several new enterprises have been attracted to the city by the low rates established for power. In all cases this is lower than it can be made for, by individual customers, and where the installation is of moderate size, the rates are exceedingly low. For a continuous consumption of, say, 50 hp measured by the customers' meters, the rates would be 1.9 cent per hp-hour, corresponding to $4.95 per month, of 26 ten-hour days. There is no place known, except Niagara Falls, where power can be obtained so cheaply and at the same time relieving the manufacturer of the expense and annoyance of operating a power plant. The plant, therefore, enables the people of South Norwalk to enjoy the advantages of lighting and power, 24 hours per day, under most favorable conditions, of excellent quality and at remarkably low rates.

The building, now nearly double its original size, is a substantial brick structure, 48 ft. wide, and 109 ft. long. It has coal house extension with a capacity of 100 tons and is located adjacent to the railroad depot, not far from the center of distribution. In addition to the electric lighting plant, the building contains the city fire alarm system, and the power house whistle is used in connection with the fire bell to sound alarms. The chimney, built in 1898, to replace the original iron stack, is of red brick, built on a natural rock foundation, and in its base is located a fire-proof safe deposit vault for the city records. The "Enlargement of 1903" was decided upon after a careful investigation and report confirming the recommendations of General Superintendent Winchester, made by Prof. George F. Sever, of Columbia University, to a committee appointed by the council. In October, 1902, an appropriation of $20,000 was made to carry out these suggestions. The recommendations advocated the removal of the original belted engine with the two arc dynamos and

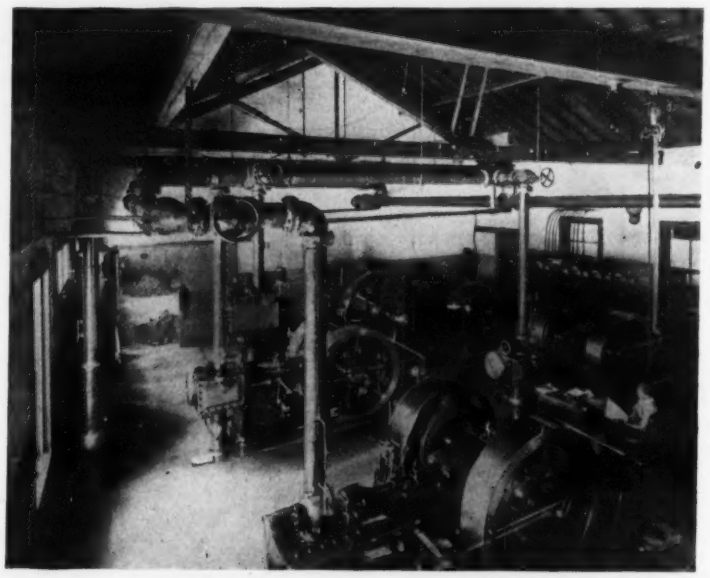


FIG. 2.—VIEW OF INTERIOR OF STATION.

the substitution for these units, of a motor-driven arc machine, capable of supplying 130 enclosed arc lamps, and the installation of a large modern unit to assist in supplying the commercial circuits. The load increased so rapidly that the existing equipment was threatened with serious overloads, until the installation of the new apparatus was completed.

One of the advantages of the new arrangement is that the arc lighting circuits are no longer dependent on any one engine for their operation, as the motor is driven directly from the bus-bars, and any of the five units, operating at 250 volts, has sufficient capacity to operate it. The space occupied by the motor-driven arc unit is so much less than the previous belted arrangement that it was possible also to place the 165-kw direct-connected unit in position without any addition to the building, or changes to the remaining apparatus. Careful records of the load show that this unit is normally sufficient to carry the arc lighting system and a considerable portion of the commercial load without operating the other engines, except at night, during the peak of the load.

The report by Prof. Sever recommended charging for electric current by means of meters, as the business had outgrown the scope of the contract system then in use. The meters have been installed, and their effect on the load curve of the plant is very interesting. The peak becomes sharper and the all-night load is less, showing conclusively that many people were negligent in using current when unnecessary in the old system of flat rates. Another interesting feature is the great demand for 8-cp lamps for residence lighting, in the place of 16-cp. On the whole, the customers appear to be very well satisfied with the meter system, and many find a considerable reduction in their bills over the old rates.

Specifications were prepared by the general superintendent, cover-

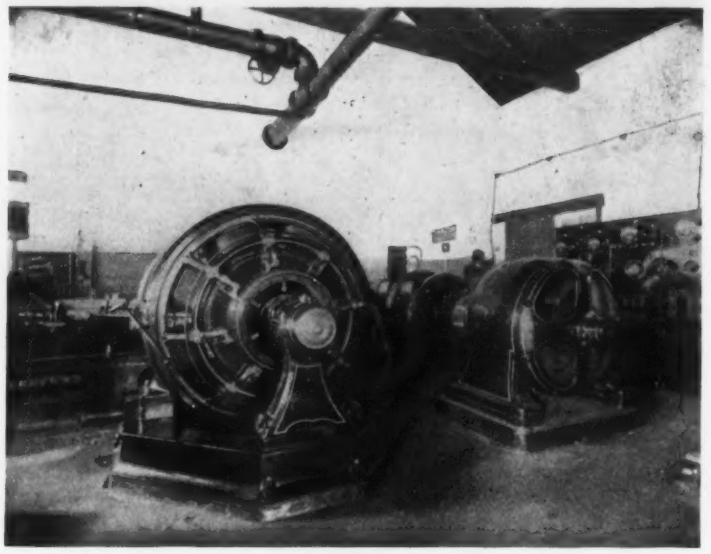


FIG. 3.—THE NEW UNITS.

ing the "enlargement," and after being duly advertised, the conract was let in open competition to Messrs. Bellman & Sanford, of New York City, as general contractors to carry out the work. The motor-driven arc machine consists of a No. 12 four-circuit Brush machine operating at a speed of 500 r.p.m., and connected by means of a flexible coupling to a 90-hp, 8-pole motor. Both of these units were supplied by the General Electric Company, and are mounted upon an oak sub-base to insulate them effectively from the floor. The specifications called for uninterrupted operation of the city lighting system, and the old apparatus was shut down at one o'clock one night, the machinery dismantled, and the new apparatus set up and in working order before six o'clock the evening of the same day. The unit has been in operation uninterruptedly ever since that time, and has given complete satisfaction. The new switchboard panel was built to match the old switchboard, and all the switches were designed to be duplicates of those at present in use. The switchboard work was accomplished in such a manner that there was no interruption to the street service and the clause in the specifications requiring that continuous operation should be maintained was fully carried out, for which Messrs. Bellman & Sanford deserve great credit. After the arc machine was erected, the foundations for the new unit were built the unit erected thereon and the new piping connected to the present mains.

The large unit consists of a 165-kw, 250-volt Fort Wayne generator, direct-connected to a 20 x 18 Watertown four-valve engine. This unit is mounted on a common sub-base of cast iron that rests upon massive foundations. The generator is guaranteed to carry an overload of 50 per cent. for two hours withut distress, and the engine will drive it under these conditions by slightly increasing the cut-off. The steam economy of this unit operating under full load is guaranteed to be 27 pounds when operating with 90 pounds steam pressure non-condensing. The generator efficiency is 92 per cent. at full load. The combined efficiency of these units is so high that at full load. The combined efficiency of this unit is so high that it is effecting a considerable saving in the operating expenses of the plant over the three small units which it supplements.

The design of the plant arranged for two steam mains cross-connected. By closing proper valves, it was possible to erect the new piping without interfering with the operation of the plant. Extra heavy piping was used throughout and the joints made up with 1/16-in. rubber packing. The pipe covering used was a combination of asbestos and cork, neatly covered with canvas and painted to match the other piping.

The old type open arc street lamps were replaced with modern enclosed arc lamps, which operate on a 5-amp series current. These lamps are manufactured by the Fort Wayne Electric Company. The cases are of sheet copper, and entirely water and bug proof. The former attribute is very necessary owing to the heavy fogs and storms along the coast. The efficiency of these lamps is greater than the old type and the diffusion of the light by the inner globe makes them more satisfactory to the city. The result of the better illumination is at once apparent on the streets.

After the installation of the machinery was finished, a test run of one week was made, to show that it fully complied with all of the specifications. It was then painted and striped to match the remainder of the machinery in the power house, and all the work left completed to the satisfaction of the general superintendent, and reflects most favorably on the skill and expertness of the contractors.

The results of the change and the improved machinery are already apparent in the economy of operation. Where it was previously necessary to operate four boilers, on the peak load, from two to three carry it now without difficulty. The average saving is nearly a ton of coal per day. This great saving is due to the higher efficiency of the new engine and the greater economy of the motor-driven arc machine. In addition to this, there is a considerable saving in the labor of trimming the lamps, as the new lamps burn 100 hours at a trim, compared with the old ones, which burned only 14 hours.

The plant to-day is thoroughly modern, inventorying about $88,000, of which about $16,000 has been paid from profits. Its normal capacity is 700 hp, supplying 108 street arc lamps, a commercial load

FIG. 4.—VIEW OF SWITCHBOARD.

of between 6,000 and 7,000 16-cp lamps connected and electric power for 26 manufacturing concerns.

During the eleven years' existence of the plant it has saved the city in the item of street lighting alone, including all operating expenses, interest, depreciation, etc., over $27,500 as the difference between the average rate of the State, and what the cost has been from the city plant. As the original cost to establish the street lighting system was $22,500, the saving has not only paid for the plant, but leaves a net balance of $5,000 to the good. Aside from this, the commercial income yields an annual profit varying from $3,000 to $5,000, which is used to reduce the debt, and in time, under favorable conditions, as judged by the past results, will eventually free the plant of debt.

Probably one of the greatest, if not the greatest, factor in the success of this municipal enterprise may be traced to its independence from politics, which never have had any voice in its management or appointments, and the fact that it is operated to all intents without dictation from the local government.

The Recent Great Fire in Baltimore.

FIG. 1.—ELECTRIC LIGHT POLE.

THE great fire in Baltimore, which, breaking out on Sunday morning, February 7, destroyed probably $100,000,000 in property in the space of 48 hours, has already had its main features made known to every one who reads the daily newspapers. It has also been profusely illustrated from pretty well every point of view. It is not necessary, therefore, that in referring to the electrical conditions there we should repeat that which has already been covered almost *ad nauseam*. As has already been mentioned, the telegraph, telephone, electric light and street railway services suffered severely and their financial loss was considerable; although the interruption to service was remarkably short owing to the energy displayed by the officials of the various companies. We are glad to be able, however, to to present a few views of the devastation from some snapshots taken by Mr. Douglass Burnett, formerly of the New York Edison system, who has but recently become general manager of the United Electric Light & Power Company, of Baltimore, and who, in fact, may be said to have received thus his "baptism of fire" on being inducted into his new position.

The snapshots shown are some of those taken February 8 and 9 in the burned district, one of them, Fig. 2, looking north on Charles Street from the corner of Baltimore Street toward the Union Trust Building. It shows the overhead wires, which, curiously enough, were to have been abandoned upon the opening of the subway system on February 10. Invitations were to have been mailed on the Monday morning, the day after the fire, for the opening of the new rotary station on McClellan Street. The opening was to have taken place on Wednesday afternoon at 3.30, when the United Company expected to turn current on to the new underground, three-wire, direct-current system. Fig. 4 shows the new McClellan Street station, which had a most fortunate escape, the only damage being the breakage of the windows through the falling of neighboring walls. Fig. 5 shows the rotaries, transformers, etc., in this station after the fire. The building is surrounded by walls of gutted buildings in every direction, but the management has noted no damage was done to it except where the wire glass was cracked by the heat and where some of the sashes were broken by falling walls and bricks.

The United Company's men received the first fire signal when the automatic alarm in the Hurst Building not far away went off, and several of them went immediately to the premises, arriving when the first explosion occurred. Mr. Burnett himself saw personally the first flames burst from the building and was on his way to it and within two blocks of it at the time of the explosion. He and his men were thus on the ground from the very beginning of the fire. The service was shut down as soon as practicable, but the city lighting was resumed a few minutes after dusk in all but the burned territory; and the power circuits were in operation next morning. The McClellan Street station and the Pratt Street railway power house, both of which stood up so wonderfully while in the thick of this unexpected fire, were designed by Mr. P. O. Keilholtz, consulting engineer of the company. In all probability Mr. Keilholtz did not have the remotest idea that his work would ever be subjected to such a test and strain as this; but he would wish no better example of endurance in design and equipment than was afforded at both places. It still remains a wonder that both plants were not wiped out of existence, and central station men might doubtless do worse than study the features of construction embodied in the stations named. As we understand it, the fire would have destroyed Pratt Street had the material there afforded the least encouragement.

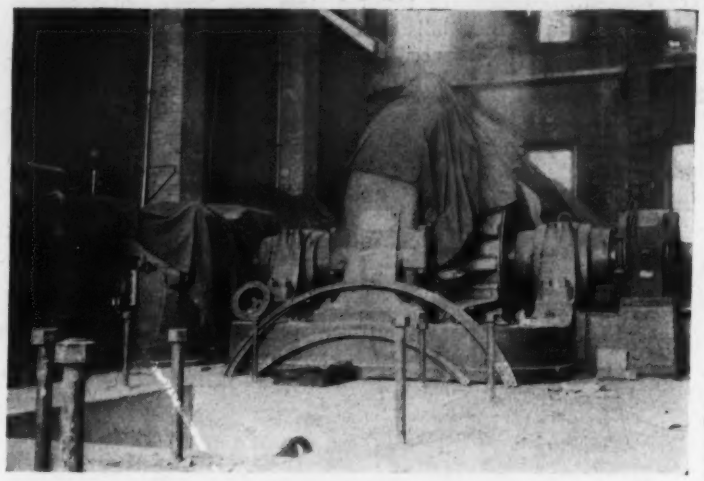


FIG. 5.—INTERIOR OF STATION.

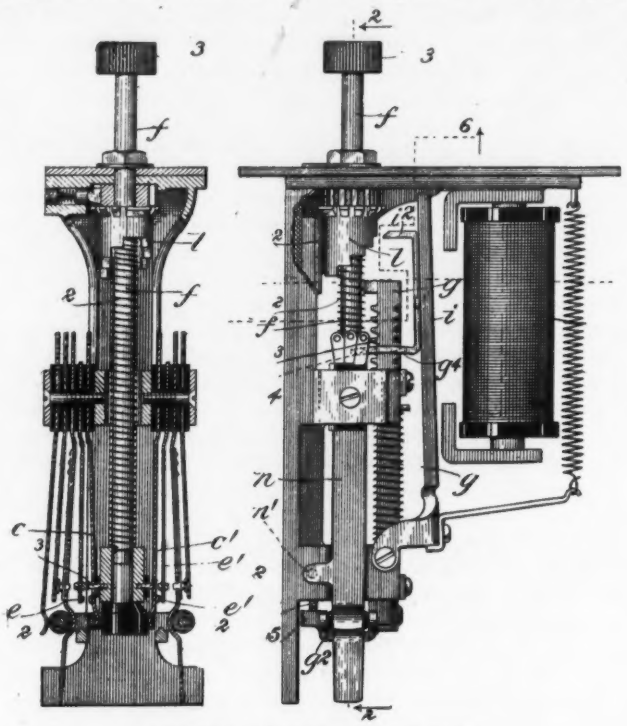
It is a remarkable fact that while 30 city arc lamps on a rough estimate were in the burned district, a number of them were in place or could be readily renewed. One of the views herewith, Fig. 1, shows one of the several city arc lamps in the district with the globes, lamp and the shepherd's crook intact, the wooden post being partially burned away. Another view, Fig. 3, shows the Hotel Carrollton on the left; the Continental Trust Building in the middle distance, where the Postal Telegraph Company's headquarters were wiped out, and the Maryland Trust Building on the right. The fire alarm box can be seen in the foreground. As usual, it was one of the curiosities of the fire to notice what was destroyed and what by some inexplicable chance was left standing and almost unharmed.

FIGS. 2, 3 AND 4.—VIEWS OF THE BURNED DISTRICT.

New Telephone Patents.

CODE-RINGING KEY.

Probably the most extraordinary ringing key of recent years is one for automatically giving code signals on non-selective party lines, which has recently been invented. With such a key it is aimed to overcome the drag upon the operator occasioned by the time and care necessary to send clear and distinct signals. Incidentally, at least one source of annoyance to subscribers is removed. This results from the fact that an indicator serves to show what code was last sent out on the key and the operator may repeat it in case of failure of the called party to answer without the necessity of questioning the calling party as to the station desired before an additional signal may be sent. A side view of the key as developed is shown in Fig. 1, together with a sectional view which shows the arrangement of springs. What may be called the key to the situation is, however, not shown, being an interrupter continuously driven, and included in the current leads which supply the keys. This interrupter times the interval between, and the duration of, the component rings which form the signal. It consists of two elements —that which controls the ringing current and that which controls a direct-current circuit, which restores the key to normal after the completion of the desired signal. These are so mounted upon their common shaft that the angular position of a dead segment of one corresponds exactly with that of a live segment of the other; that is



SCRIBNER-M'BERTY RINGING KEY.

to say, that while the restoring current is being supplied the ringing current is cut off and vise versa. The operation of the key is effected from a single button, which has two motions—a rotative one about its spindle as an axis, and a vertical one. The process of sending a signal first requires that the button be rotated until a pointer traveling with it indicates the desired party number upon a dial formed upon the key face. There is also traveling with the key spindle a stepped collar, *l*. This engages the ratchet bar, *g*, and the ultimate depression of the ratchet bar is dependent solely upon which step of the collar is in position to engage the bar. Ten-party lines are evidently contemplated, the bells of five stations being on each side of the line, the return circuit being earthed. Therefore, a switching device must be provided to connect the generator to the desired side of the line. This comprises the two sets of springs next the plunger, marked *C e'* and *C'e'*, together with the cam wedge of hard rubber secured to the end of the push spindle. This cam is so shaped that when turned to the right it affects one pair of springs, so that the ring is on one side of the line, and if turned to the left the other side of the line will be rung upon.

As soon as the key has been set and the depression begins, the supply of ringing current is temporarily cut off. Next the ratchet bar becomes engaged and depressed. This affects the ringing key proper, this embracing the outer sets of springs. However, no signals are sent as the current supply is cut off until the plunger returns to the uppermost position. This it strives to do as soon as released; but it only succeeds in doing it at a time when the interrupter is on a segment corresponding to silence of the bells, as its motion is restrained by the dog i_2, except when the armature *i* is pulled up. If this provision were not made the first ring might be of irregular duration. When the plunger has returned home and closed the ringing supply to the key, the code ringing begins, following the commutator; at each silent period the wedge of the ringing springs returns one step toward the normal position, being stepped along by the detent vibrating by the restoring magnet, as this receives direct curreent from the commutator during the silent periods. When the normal is finally reached the ringing springs become released by the wedge rolls dropping into their grooves. Just as this occurs a small pawl which has been restraining the plunger from being depressed during the automatic operations, is tilted to free the spindle for a further signal, should this be found necessary. Two patents have been granted for this key, both assigned to the Western Electric Company. C. E. Scribner has obtained one of these, while Frank R. McBerty has been granted the other one.

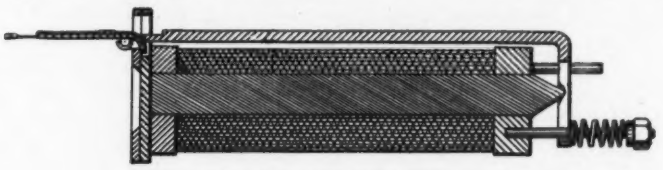
HAND TELEPHONES.

Two patents have been granted for designs of hand telephone apparatus. One of these describes a receiver of the general outward appearance of the old Bell hand telephone. The novel features, however, are several in number. First of all, the diaphragm is given an initial tension by an annular spring, which is forced upon it by the receiver cap. This bows the diaphragm toward the magnet pole. Second, the diaphragm is provided with a pole piece. This enters the end of the coil spool, the magnet being cut short to permit of this. The combined result, the inventor, Mr. Ernest Gundlach, of Western Springs, Ill., states, is an increased efficiency.

The second hand telephone combines a transmitter, a receiver and a calling buzzer within one piece of apparatus, the whole being assembled after the manner of the hand microphone of foreign practice. The calling device is contained within the receiver casing and consists of a buzzer, the magnet of which is that of the receiver. A switch upon the handle of the apparatus effects the transfer of circuits to the talking or calling conditions, as described. The whole forms a compact instrument apparently fairly well suited to the interior or house system working for which it is designed. Mr. E. T. Billig, of New York City, has obtained the patent covering this apparatus.

DIRECT-CURRENT DROP.

Fig. 2 shows a rather neat direct-current line drop which has recently been invented by Lambert Schmidt, of Weehawken, N. J. The



SCHMIDT ANNUNCIATOR.

magnetic circuit is very well designed, the air-gap being extremely small. The use of the core as a knife edge for the swinging armature is commendable, resulting in extreme simplicity of construction. The operation of the drop will be evident at a glance.

CENTRAL ENERGY SYSTEM.

A central energy system in which two repeating coils are used in each cord circuit forms the subject of a patent obtained by J. H. Lendi, of Chicago, and assigned to the Kellogg Switchboard & Supply Company. The object of using two repeating coils is that by so doing each can serve an additional function—as the winding of a supervisory relay. One winding of each coil is included in the battery supply circuit of one subscriber, while the other winding has a condenser inserted in circuit. In using the coils the condenser section of one is placed in parallel with the battery section of the other. Thus the relay armature associated with each coil responds only to the proper subscriber, while the inductive relations of the two ends of the cord circuit are such as to warrant good transmission.

SEMI-AUTOMATIC SWITCHBOARD SYSTEM.

What may be called a semi-automatic system has been invented by J. Kitsee, of Philadelphia. In this system a continuously revolving selector connects the operator to calling subscriber one by one

in the order of the origination of their calls. The selector is stopped each time a call is found until the connecting plugs have been inserted in the jacks. Then the selector starts the process of locating and connecting the operator to the next call. This scheme does not seem very practical and, therefore, detailed explanation is omitted.

SOUND INTENSIFIER.

Mr. Gustaf T. Swenson, of San Pedro, Cal., has added to the applications of the telephone as a receiver for wireless telegraph signals. He arranges two electromagnets and a battery as a shunt upon the coherer, and by this means the received signals vary the magnetization of the magnets. These latter affect respectively the two diaphragms of a sort of receiver microphone repeater, which in turn affects a telephone receiver. Of course, no questions of timbre or quality are involved, great volume of sound in proportion to the received energy being alone desired.

Ohio Independent Telephone Companies.

A meeting of the independent telephone companies of Ohio will be held in Cincinnati, February 17, 18 and 19. The purpose of the meeting is to discuss closer association among the Ohio independent companies. The Independent Telephone Traffic Association of Cleveland is back of the movement. Several weeks ago a meeting was held in Columbus with the same aims in view and a committee was appointed to take up the question. One of the chief aims of the Cincinnati meeting will be the formation of a State association to take the place of the present association, which is now practically disrupted. Following the formation of an Ohio association it is the aim to form an inter-state association to combine similar associations in several of the central states. The purpose of holding the meeting in Cincinnati is to give encouragement to the independent companies that are now working to secure admission to Cincinnati; also to demonstrate the strength of the independent move in Ohio.

A Trade Mark Decision.

Judge Brown, of the Circuit Court of the United States, District of Massachusetts, has handed down an opinion enjoining a company which renews incandescent lamps from retaining the letters "G. E." in the stems of lamps renewed. The gist of the opinion is that this trade-mark is practically removable in the remaking of lamps, since it can be obliterated at an expense of only 55 cents per thousand lamps by applying to the exterior of the stem and over the trade-mark a small quantity of chemical paste. Since the bulb is opened on remaking to insert new filaments and to fasten them to the ends of the leading-in wires with carbon paste, the application of the same paste for the obliteration of the trade-mark the court held to be an obvious expedient. The opinion states that there is strong evidence that the real purpose in affixing an indelible trade-mark was for the ordinary purpose of a trade-mark and not, as the defendants alleged, as a part of a scheme to attack its business of remaking lamps. In summing up the court says that the complainant has a valid trade-mark. The defendants without legal justification put forth lamps bearing on this trade-mark. Though they did so without any intent to deceive and have been honorable in intention and in their business methods, and so far as appears have caused no actual deception, yet the use of this trade-mark in violation of its legal rights entitles the complainant to an injunction.

Independent Telephones in Post-Offices.

A special dispatch from Cleveland, O., of February 13 says: "Frederick S. Dickson, president of the Cuyahoga Telephone Company here, has won his fight against President Roosevelt and Postmaster-General Payne. The latter, with the President's sanction, ruled that post-offices throughout the country should use only one telephone, viz.: the one that had long-distance connection with Washington. This meant the loss of a large sum to the independent telephone interests of the country. Dickson pleaded with Mr. Roosevelt to intercede, but without success. But through many Senators and Representatives he has succeeded in getting the Payne ruling modified so that the independents will have a chance.

CURRENT NEWS AND NOTES.

MICA MINES in Charleroix County, Quebec, are mentioned as places where minerals are obtainable with remarkable radioactive qualities.

TROLLEYS IN NEW HAMPSHIRE.—The electric and traction street car companies in New Hampshire, of which there are eighteen, made a disappointing showing during the last year, according to the annual report of the State Railroad Commissioners. The Manchester Street Railway was the only one which earned a dividend. The street railroads in the State have 228 miles of track, $3,552,119 stock, $2,066,000 in bonds, and $1,109,003 liabilities. The gross income was $834,894; operating expenses, $796,795; taxes and interest, $103,250, and a deficit of $65,161. The Manchester road had a divisible income of $31,807.

FREEZING OUT A LEAK.—An interesting piece of engineering was recently carried out in St. Louis. A leak occurred in one of the cofferdams being used in the construction of the foundations for the new plant of the Union Electric Company on the river front. Water from the river poured through the leak and it looked as if serious damage would result. Finally the mechanical engineer of a near-by refrigerating plant met the situation by freezing out the leak. He laid ammonia pipes from his plant to the point where the leak existed and the breach was soon closed with solid ice. The water was then pumped out and work resumed.

STEAM AND TELEGRAPH.—Echoing the sentiment and ideas of Maud Müller, the London *Daily Telegraph* discusses the recent Pilgrim dinners in London and New York, conducted simultaneously by cable, and says: "Picturesque and genial as the event was in itself, and appealing with singular success, as it does, to the spirit of friendly good humor which, happily, is the dominating factor in the intercourse between the British and American peoples to-day, it has a profound meaning, whereof serious historians of the future may well take account. The nations in spite of themselves are being knitted together by the conditions of modern intercourse and the spirit of modern science in a mesh of subtle, invisible strands which is morally as strong as hoops of steel. If steam and telegraph, for instance, had existed in the latter half of the eighteenth century it is certain that the separation of the race would never have taken place."

SALE OF FRANCHISES.—Assemblyman Finch, of New York, has introduced in the New York Legislature a concurrent resolution amending the State Constitution with regard to the disposal of franchises to public service corporations. The proposed amendment was one which would absolutely forbid the giving away of any franchise or public utility, and compel the same to be sold at public auction. In the charter of the City of New York and the charters of second-class cities this is already provided for. But the significant thing in the resolution, so far as New York City was concerned, is a provision compelling the resale of franchises at public auction every fifty years, thus compelling the street railway companies, gas companies, telephone and telegraph companies, and all other public service corporations to repurchase their franchises from the city after they have enjoyed them for a fifty-year period.

MAGNETIC STEEL.—Mr. Robert A. Hadfield, vice-president of the British Iron and Steel Institute, has taken out an American patent under date of December 1, 1903, which covers the results obtained in the now classical papers of Barrett, Brown and Hadfield, first published in the *Proceedings* of the Royal Dublin Society and later in the *Journal* of the English Institution of Electrical Engineers. From this patent it appears that the heat treatment which Mr. Hadfield gives steel, either in castings or transformer plate, is quite as important as the original crucible charges from which the steel is made. It is rather startling to have perhaps the first living authority on the practical heat treatment of special steels announce that by an ingenious use of heat treatment and composition combined, he has succeeded in producing a magnetic material showing a magnetic permeability higher, and a hysteresis action lower, than the purest iron commercially obtainable.

ELECTRIC AUTOMOBILE SPEED.—In the recent automobile contests at Ormond Beach, Fla., the speed record for electric machines was lowered by Mr. W. J. Hastings on the Baker torpedo "Kid" with a mile in 1:00⅗ min., and the kilometer in 0:37⅘ sec.

ELECTRIC POWER ON NEW YORK CENTRAL.—The New York Central Railroad Company has, according to to a dispatch from Yonkers, N. Y., promised to build a large power house in that city at a cost of $2,500,000. It has laid before the Mayor and Aldermen plans to eliminate all grade crossings in the city preparatory to the introduction of the third-rail system. The plan approved will be submitted to the Legislature for final action. It is stated that the plans contemplate the use of five tracks to Croton.

PARIS TROLLEYS AND CABS.—A cable dispatch from Paris says that the Paris cabman is being threatened with loss of patronage and power by the slowly-increasing improvements in urban transportation facilities, notably in the instance of the Metropolitan underground system, with its three- sou (three-cent) fares. The cabman's syndicate is considering a project of reducing single fares so that the first 400 meters (quarter of a mile) be paid at a minimum rate of seventy centimes (fourteen cents), and also of attaching an automatic distance indicator, the same as that used in Berlin and Vienna.

RADIUM AND CANCER.—A cable dispatch from Vienna of January 28th says: "Professor Gussenbauer, an eminent surgeon, has discovered that contraction of the gullet caused by cancer can be alleviated in certain cases by the use of radium. The experiment was made of applying sixty milligrammes of radium in a rubber capsule to the affected part. The radium rays decomposed the cancerous growth, enlarging the gullet and allowing food to be swallowed, thus obviating an operation for the introduction of food into the stomach. The experiment is somewhat dangerous until further knowledge is obtained, inasmuch as too much radium will decompose the ulcer so rapidly that there is risk of perforating the gullet."

TRADE-MARK PROTECTION.—Many of our readers are interested in an appeal that has been sent out for support of national legislation for trade-mark protection. It is believed to be very desirable, and essential to place trade-marks on an interstate footing, and bring all trade-marks used in "commerce among the several States" under Federal statutory protection. The bill introduced by Senator Stewart January 12, 1904 (Senate Bill 3353), is intended to extend to trade-marks used in interstate commerce the statutory rights and privileges accorded to trade-marks used in foreign or Indian commerce. This bill provides also for a bureau, at the head of which shall be a Register of Commercial Marks, appointed by the President, at a salary of $3,000 a year.

BEARING OIL IN INDIA.—An article in the *World's Work* for February says: "When the American Engineers were building an electric power station in the Mysore territory in Southern India they found that something was wrong with the lubrication of the machinery. The oil disappeared. They discovered that a Hindu must, by his religion, take a periodical bath in oil. To him oil is oil. The workmen had drained the bearings for bathing purposes. How to stop the thieving was a puzzling problem until some one solved it. The Hindu does not eat meat, and he will not touch anything that has blood in it. Two or three animals were killed, therefore, and blood was dripped into the bearings. There was no more stealing of oil; however many other things were stolen."

FREE TELEPHONE SERVICE IN CHICAGO.—The Illinois Tunnel Company, which operates the new automatic telephone exchange in the business district of Chicago, gave notice to its subscribers February 5 that all service would be free up to April 1, 1904, and that all charges for past service would be canceled. The object is to educate the public up to using the new automatic service. So far the automatic telephone has not been used as much as it might have been had it not been on a strictly measured rate of 5 cents per call, whereas many of the Chicago Telephone Company's instruments are on a flat rate and others are on a guaranteed minimum rate for measured service; so that the automatic telephone would only be used when the old telephone was busy, or especially quick connection was desired.

INSTITUTE BUILDING FUND.—The Building Fund Committee of the American Institute of Electrical Engineers has taken hold very vigorously of its work of raising funds from among the members primarily, and next from electrical concerns benefited by engineering progress. It has just addressed circulars to all the membership, from which it has already raised considerably over $30,000, some sums being promised in a lump and others spread out over a term of five years. The committee hopes to secure practically the name of every member on this subscription list, and is greatly encouraged by the hearty and public-spirited responses it is receiving from all over the country. A careful and elaborate plan of campaign, to which we shall again have occasion to refer, is being inaugurated and is to be persistently pushed.

A. I. E. E. PHILADELPHIA LOCAL MEETING.—At a meeting of the Philadelphia Branch of the American Institute of Electrical Engineers, at the Engineers' Club, of Philadelphia, on the evening of February 8, Mr. C. E. Bonine gave a talk on the "Principles of Alternating-Current Motors," which was followed by an abstract by Mr. E. P. Coles of Mr. Walter I. Slichter's paper on "Speed-Torque Characteristics of the Single-Phase Repulsion Motor," and Mr. Charles P. Steinmetz's paper on "The Alternating-Current Railway Motor," which were presented at the New York meeting. Mr. C. E. Renshaw, of the Westinghouse Company, Pittsburg, gave a paper on "Alternating-Current Railway Motors." Mr. Renshaw dwelt upon the many advantages the alternating-current motor has over the direct for railway purposes, and went into details as to the principles governing the single-phase alternating-current motor. The discussion was participated in by Messrs. Cutler, Thomas Spencer and Breed.

WIRELESS IN BRAZIL.—Mr. K. K. Kenneday, United States Consul at Para, Brazil, writing recently says: "Experiments with a wireless telegraph system which have been quietly carried on between Manaos and Iquitos during the past few months have shown such satisfactory results that the cable company has bought the right to use the system between Para and Manaos, and the manager of the Manaos office is now in Para making final arrangements for installing the system. No other improvement is so important to the commercial interests of the Amazon Valley as the installment of a reliable telegraph service between Para, Manaos and upriver points. Owing to the character of the country through which it must pass a land line is impossible, and it has been found equally impossible to keep a cable line in steady operation. The present cable, recently laid and maintained at an enormous expense, is rarely in working order more than one or two days per week. The rapid and violent fluctuations of exchange in this country render it almost vital for merchants, shippers and brokers to keep in close and uninterrupted touch with their branch houses and agents at all points, and the constant breakages of the cable are looked upon as a calamity."

STATE GUARD ELECTRICIANS.—A bill is before the New York Assembly providing for enlistment of five technical expert civilian electricians as engineers of heavy artillery National Guard State of New York, for service in coast defenses, has been introduced and passed in the lower house with a fair chance, if pushed, of passing the State Senate and becoming a law. This bill, as we understand it, is the outgrowth of articles published a year or more ago in ELECTRICAL WORLD AND ENGINEER and was proposed or endorsed by members of the American Institute of Electrical Engineers, who took up the subject of having the National Guards of Massachusetts, Connecticut and this State (the only ones with heavy artillery organization), employ, with sergeant's rank, technical electrical engineers from civil life to handle coast defense plants such as are used in practice drills at Willets Point, Fort Totten and other coast defense points. We published several articles about it and described the manœuvres and experiments, at Fort Terry, of a volunteer engineer, Sergeant M. C. Sullivan, of one of the Thirteenth Regiment's companies, who gave a demonstration at the Military Tournament last year, in Madison Square Garden. We understand Col. Austin, of the Thirteenth, and Capt. Taylor, of the same regiment, are deeply interested in this bill.

LETTER TO THE EDITORS.

Radium and Helium.

To the Editors of Electrical World and Engineer:

SIRS:—Considering the intense interest manifested in the marvelous performances of radium and kindred substances, would it be proper and permissible for a layman to put in a word on the subject?

Two statements recently made seem suggestive of a probable solution of the problem. The one is that radium maintains a higher temperature than its surroundings, the other that the emanated matter is helium. Does not this indicate that the phenomenon must be supposed analogous to what is commonly called combustion? This would, of course, imply that helium is a compound, not an element, but is there anything impossible in that? A piece of charcoal, for instance, at red heat, exposed to oxygen mixed or combined with other matter, will issue carbonic acid or other gases as the case may be—whether with or without measurable wave lengths I don't know. But the process will keep the temperature of the coal above that of its surroundings and the expelled—emanated—gases will give off their heat to whatever they strike and remain gaseous until a very low temperature is reached, exactly as in the case of radium. That the gases are expelled at a greater rate of quantity and a smaller rate of speed than the helium, does not alter the apparent similarity of the process.

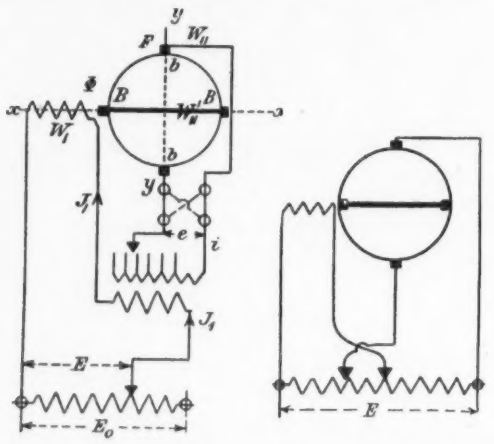
But this surmise would also imply that radium diminished in quantity by the so-called radiation. Perhaps it does, unless something is added to it from a source unknown. There would still be room for much interesting research, and more wonders may yet be found in connection with it.

CHICAGO, ILL. S. T. SUE.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Single Phase Commutator Motor.—EICHBERG.—A very long paper, illustrated by a great many diagrams, on single phase commutator and their regulation. The author first discusses in general the phenomena which are of importance in a commutator motor and gives a review of the properties of the ordinary series motor and repulsion motor and deals finally with the Eichberg-Winter motor. Its arrangement is diagramatically shown in Fig. 1. Both the exciting voltage e and the total voltage E can be adjusted, although in high voltage motors the regulation of E would be inconvenient. The motor has a single phase stator winding and a rotor which is absolutely identical with a direct-current armature. The rotor winding is used in a double way. In one axis it is short-circuited so that it may be considered to form a short-circuit winding W_{11}^{1} for the stator winding W_1. In points (brushes $b\,b$) which have the same potential as the short-circuited brushes $B\,B$, the exciting currents are introduced. It would, of course, be just as well possible to provide two separate commutator windings. With a two-pole arrangement it is necessary to use four brushes. With 2-p-pole series windings or parallel winding with Mordey connections, four brushes are also required; in the most general case $2p$ short-circuit and $2p$ exciting brushes may be used. The exciting current i itself is furnished by an adjustable series motor (or potential regulator). It is therefore always in phase with the primary current J_1. During



FIGS. 1 AND 2.—SINGLE-PHASE COMMUTATOR MOTOR.

starting, W_{11}^{1} is essentially a short-circuited transformer which represents a relatively small impedance. With increasing speed, there is produced in W_{11}^{1} (between the brushes $B\,B$) an e.m.f. in phase with i or J_1. The windings $W_1\,W_{11}^{1}$ therefore form together with increasing speed a transformer with an ohmic resistance load. In accordance with the increase of this load with increasing speed, the field Φ increases. The secondary circuit of the series transformer represents in the first moment a relatively high impedance. The less secondary turns are connected to the exciting circuit $b\,b$, the greater is the impedance of the series transformer. During starting, a very large part of the total voltage will be consumed by the transformer. With increasing speed, there will be produced between the brushes $b\,b$ an e.m.f. in phase with Φ. This annihilates the self-induction in the exciting circuit, and at a sufficiently high speed the secondary of the transformer will possess only a very small voltage, corresponding to the ohmic loss in the winding and the slot leakage. The total voltage E resolves itself during starting in such a way that W_1 gets a small pressure which, however, increases with increasing speed and soon reaches nearly the full value, E. The presence of the "cross field" Φ makes it possible to annihilate the short-circuit e.m.f. simultaneously with the annihilation of the inductance of the excitation winding. By varying the transformation ratio it is possible to adjust the ratio of F to Φ. Stator and rotor winding are independent of each other. It is therefore possible to apply directly a high voltage. In spite of the use of only one stator winding, the motor can be reversed, even without opening the stator circuit. If the secondary number of turns is increased, we get a higher speed for the same torque or a higher torque for the same speed. One may therefore start, without varying the primary voltage, simply by increasing the number of secondary turns. By this arangement it is possible to start, reverse, and stop the motor, without interrupting the high tension circuit. The curves obtained by the motor have already been reproduced and discussed in these columns. It is possible to arrange the motor so that it starts with full torque and maintains a given speed. The voltage at the exciting circuit and at the stator has approximately the same phase for nearly all speeds. It is therefore possible to get the voltage for the exciting circuit and the stator from the same transformer, the stator voltage being increased and the exciting voltage being diminished with increasing speed. Near synchronism only a few volts are used for excitation. Fig. 2 shows the arrangement which the author believes to be specially suitable for elevators and machine tool driving. The author sums up as follows what he considers to be the essential accomplishments of his system: The production and independent adjustment of the two fields, F and Φ in Fig. 1, results in the annihilation of the short circuit energy below the brushes and of the phase difference of the motor within wide limits. It is further possible to change the characteristic curve of the motor with constant total voltage (of the supply network), or, in other words, to get any torque at any speed. For high-tension motors it is possible to start, reverse and stop the motor, without opening the primary circuit. The motor has all good properties of the direct-current traction motor, among them the good action of commutator and brushes.—*Elek. Zeit.*, January 28.

Magnetic Dispersion in Induction Motors.—BEHN-ESCHENBURG.—

An abstract of a paper read before the British Inst. Elec. Eng. The dispersion coefficient is defined as unity minus the ratio of the product of the coefficients of mutual induction to the product of the coefficients of self-induction of the primary and secondary windings respectively. It may be obtained experimentally as the ratio of the magnetizing current to the short-circuit current at equal terminal potential differences. It may be regarded as the sum of three distinct coefficients; first, the winding coefficient; secondly, the peripheral disperson; third, the flank dispersion. Concerning the first coefficient he says that in every motor a difference exists between the self-induction of the winding of one system and the mutual induction between corresponding portions of the windings of the primary and secondary systems, even if there were no so-called magnetic leakage to influence the relation. The reason is that mutual induction is the sum of the products of the magnetic lines by the number of conductors interlinked by each. Even if no magnetic line produced by the primary current fails to interlink with the secondary circuit, the number of times it interlinks the secondary turns depends upon the relative positions of the two circuits. There will be a relative position giving the maximum mutual induction, and one giving a minimum, and since one position is obtained from the other by steady motion, the average value will be the arithmetic mean of the maximum and minimum values. The winding coefficient is defined as half the difference beetween the maximum and minimum values divided by the maximum value. This coefficient is less the larger number of slots of the primary on the one hand or of the secondary on the other. In every motor, however, there come into operation magnetic leakages which may be separated into two stray fluxes so that we may distinguish between peripheral dispersion and flank dispersion. Peripheral dispersion runs along the face of the bore of the stator and along the phase of the cylindrical periphery of the rotor, since between the tops of the iron teeth of each single system over the openings of the slots there occurs a leakage of magnetic lines. These stray fluxes along the peripheral surfaces will bear to the mean total flux the same proportion as the magnetic reluctance of the path followed by the mean total flux bears to the magnetic reluctance interposed in the path of the stray magnetic flux between the tops of the teeth. The quotient of the stray flux by the main flux is called the peripheral dispersion coefficient. The second kind of magnetic leakage, called flank dispersion, exists outside the iron core. Those parts of the winding which constitute the end connections between conductors in the slots, and which project as curved winding bunches or bends at the flanks of the stator and rotor cylinders, give rise to a magnetic flux outside the iron core bodies. In the main this stray flux is equal to the magnetic flux

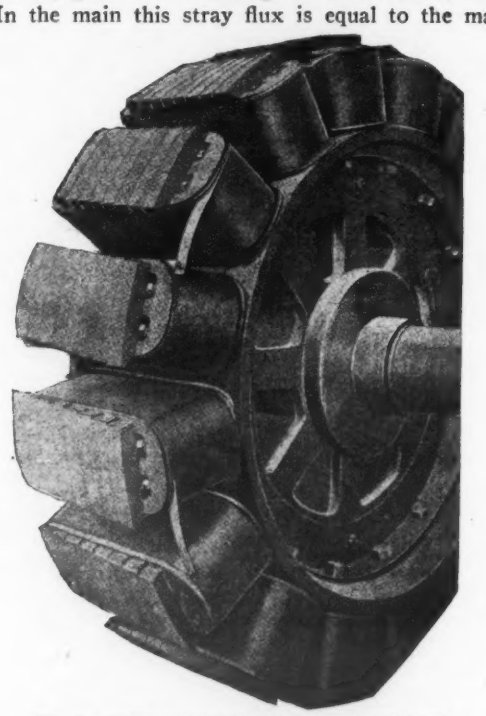


FIG. 3.—POLE CONSTRUCTION OF ALTERNATOR.

which would be created by an independent group of coils of a form similar to the two projecting bends at the two flanks, if put together as a coil. The author gives approximate formulas for calculating these three coefficients and by adding them he gets the total dispersion coefficient. He thinks that this coefficient may well form the basis upon which to design induction motors as upon it depends the power factor.—Lond. *Elec. Rev.*, January 29.—An illustrated reprint in full of the paper begins in Lond. *Elec.*, January 22.

Alternators Giving a Pure Sinusoidal e.m.f.—PATERSON.—A fully illustrated article in which it is said that the Oerlikon Company built the generators for the Lauffen transmission in 1891 with their pole pieces set at an angle to the axis of the pole wheel, with the result that the wave of electromotive force was very nearly a sine curve. The same firm is now building generators on this principle, and Fig. 3 shows the special pole construction. The iron is laminated throughout, the stamping being arranged in such a way that the polar edge makes an angle with the axis of the wheel. The distribution of flux with relation to the stator conductors tends to produce the desired effect.—Lond. *Elec. Rev.*, January 29.

REFERENCES.

Auxiliary Poles for Direct-Current Machines.—PUNGA.—An article referring to the paper of Pichelmayer who, as was recently noticed in the Digest, recommends the use of auxiliary poles for generating a special commutating field in order to insure perfect commutation. The present author remarks that such auxiliary poles have repeatedly been suggested before, but their use has distinct practical disadvantages which make the design difficult. Compared with the normal direct-current machine, a machine provided with auxiliary poles is more expensive. The use of auxiliary poles will be only justified when the voltage and the speed are comparatively high so that the design of a normal machine would become impossible, for instance, in the case of a 500-kw machine running at 1,000 revolutions per minute. In connection with steam turbines the use of auxiliary poles should be in place.—*Zeit. f. Elek.* (Vienna), January 24.

LIGHTS AND LIGHTING.

Three Phase Arc.—MERCANTON.—An account of experiments which he has made with a three-phase are, using three carbons arranged symmetrically and inclined to each other so as to form a triangular pyramid. The results depend to some extent upon the nature of the carbons used. The carbons should contain substances capable of volatilizing and "nourishing" the arc. Fig. 4 shows the

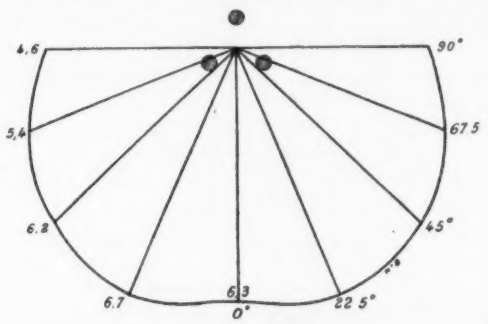


FIG. 4.—THREE-PHASE ARC.

results of photometric measurements with one set of such carbons, the lengths of the radii representing the candles per watt so that for 0° one watt gives 6.3 candles or reversely 0.160 watt is consumed per candle, which is a rather good efficiency. In spite of the advantages of the three-phase arc he thinks that mechanical complications would prevent its introduction into general use, but for special uses where regulation by hand is possible, and especially in connection with searchlights, the three-phase arc is thought to be able to render important service, on account of its steadiness and high light effect.—*L'Eclairage Elec.*, January 30.

Triplex Lamps.—HOPPE.—The first part of an article in which the author discusses the result which have been obtained in practice with the connection of three 35 to 37-volt arc lamps in series across 110-volt mains or of six such lamps in series across 220-volt mains. The advantage gained is that no energy is wasted in series resistances (as is the case with two 42 to 46 lamps in series across 110-volt mains). But on account of the series resistance being avoided, certain conditions must be vigorously fulfilled, if the light shall be good and steady. The regulating devices must be absolutely exact and in good working order, the best material must be used for the

carbons, and there must not be any large variations of the voltage of the mains. Moreover, these lamps need special attendance, and if one lamp comes out of order, a comparatively large number of others is involved. The article is to be concluded. In the conclusion the author proposes to discuss the question of cost.—*Elek. Anz.*, January 24.

REFERENCES.

Lighting.—Lummer.—The first part of an article in which the author emphasizes that in spite of the enormous development of electric lighting we have not made any radical progress in the principal problem of lighting. The goal to strive at should be to produce light without heat. We need cheaper light, not more light. To test the progress made by a new system of lighting, it has been considered all-important to determine the price per candle. Although this value is practically important, it does not give any indication of the real economy, i. e., the ratio of the light produced to the energy consumed. The lighting engineer should base his researches more on scientific principles.—*Zeit. f. Belenoht*, January 10.

Power.

Individual Motor Drive.—Cooper.—An article in which the author points out that in many cases motors are used for driving machine tools which are entirely too small where they are expected to yield a considerable range of speeds by field regulation. Some examples of this kind are mentioned. When installing an electric motor it is important to know the conditions under which the maximum amount of power is required. If the maximum power be coincident with the maximum speed, and the amount of power decreases with the speed, a motor having field regulation is ill adapted to the work of furnishing different speeds. If the power required is nearly constant or if it decreases as the speed increases, this method of regulation is much more applicable. Some remarks are made on the determination of the maximum power required. Due consideration should always be given to the well known facts that the power of a direct-current motor decreases in inverse ratio as the increase of speed when the speed is increased by field regulation, and that the power increases in a direct ratio as the increase of speed when the speed is increased by increasing the volts impressed upon the armature. With field regulation the limiting condition is the tendency to sparking at the commutator, while with regulation by varying the impressed voltage, the limiting condition is heating of the armature. If it is desired to increase the speed 100 per cent. by field weakening, one must have 100 per cent. margin for sparking at normal speed, if the motor is to carry normal load at the increased speed. The same is true in regard to heating, if the speed is to be decreased by lessening the impressed volts. These rules are graphically represented in a diagram. A motor whose speed is to be varied by changes in voltage, field excitation remaining constant, will be directly proportional in size to the change in speed; while a motor whose speed is to be varied by change of field excitation will be in size as the square of the change of speed. For determining relative sizes of motors for constant horse-power application, the following rules are given: The total range of speed, using both variable voltage and field regulation, is as the square of the range of voltages. The change of horse-power is directly proportional to change of voltage on armature, field being constant. The change of horse-power by change of field strength is inversely proportional to change in speed, the voltage on the armature remaining constant. The relative size of motor, as referred to the maximum speed, is directly proportional to its speed variation when using variable voltages. The relative size of motor, as referred to the maximum speed, is as the square of the speed variation when using field regulation.—*Cassier's Mag.*, February.

Electric Power in Australian Railway Workshops.—An illustrated description of the electrical equipment of the railway workshops at Ipswich, Queensland. The power house contains three 200-kw generating sets each consisting of a single-acting compound engine directly connected to a 220-volt, 60-cycle, two-phase alternator. The motors installed vary from 1 to 75 hp and are all induction motors, the majority with squirrel-cage rotors. The number at present installed is about 170 and the aggregate power over 1,200 hp. Where speed regulation is required, the squirrel-cage rotor is replaced by a wound and insulated secondary, connections from which are made by means of collector rings on the shaft to external resistances. Thus the motor is enabled to exert full load torque at a number of speeds less than ful speed, depending on the number of notches in the controller. For crane work, however, suitably designed squirrel-cage motors can be used. The shop equipment includes 11 cranes, each operated by three motors, one for hoisting, one for cross traversing, and one for traveling.—Lond. *Elec.*, January 22.

Power Plant of Apartment House.—Moses.—An article on the general arangement of the power plant and mechanical equipment of apartment houses. He recommends to get steam from the boilers at 100 to 150 pounds pressure, to use it expansively in the engines, etc., taking a few of the heat units available and allowing the pressure to drop from this initial to 2, 3, 4, 5 pounds as required. Thus, a portion of the energy of the steam is used for producing power, after which it enters the heating system, the drying coils in the laundries and the heater for the water fed to the boilers. In these it loses its latent heat and becomes condensed and returns to a receiving tank, whence it is pumped and returned to the boilers. The following three wiring systems are in use in apartment houses: two-wire 125-volt direct-current, three-wire 125-volt direct-current (one wire having double the carrying capacity of the others so that this is really a two-wire system with one of the wires split in two); a three-wire system with 240 volts between the outers. The first system should be used where no outside service is required; the second where outside service is required for lighting only; and the third where the outside service is required for lighting and power both alternately with the plant. The mechanical equipment is discussed in detail.—*Eng'ing Mag.*, February.

REFERENCES.

Large Electric Distribution System in Switzerland.—A note stating that the 10,000 water power station near Vallorbe has recently been completed and supplies not less than 190 municipalities with light and power. Current is generated at 13,000 volts and distributed at this voltage.—Lond. *Elec.*, January 29.

French Water Power Plant.—Domar.—A description of the Louziere hydroelectric plant which supplies current to a calcium carbide factory. There are three generating sets, each consisting of a 500-hp turbine coupled with a two-phase alternator.—*L'Eclairage Elec.*, January 23.

Traction.

"Tangential Traction."—Rosenfeld and Zeleney.—Some detailed information on this system which has been noticed briefly before in the Digest, and in its original form described in detail in an article printed several years ago. The principle is that a three-phase winding produces in a stator built up between the rails of the track, a horizontally moving field which corresponds to the rotating field produced by the stator of an ordinary three-phase machine. One

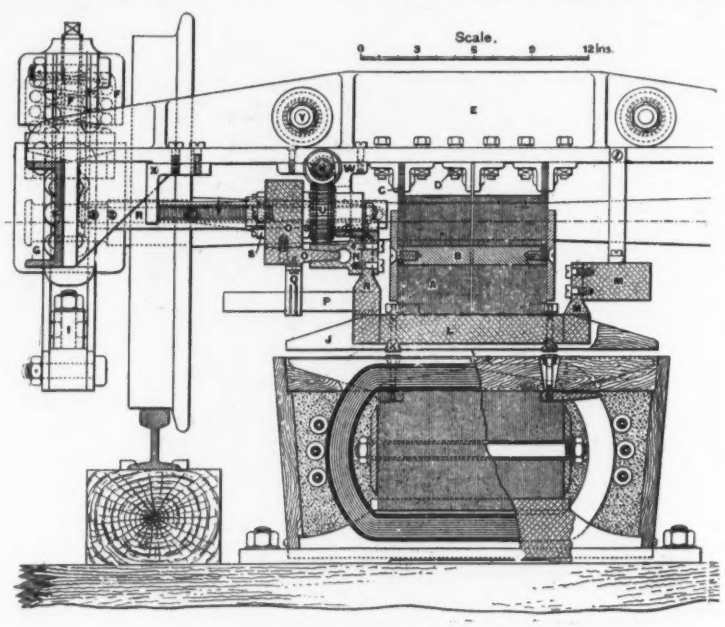


FIG. 5.—"TANGENTIAL" TRACTION.

may consider the stator laid along the track as part of an ordinary stator with an infinite diameter. The magnetic flux, travelling approximately at train speed, cuts the conductors of that part of the system corresponding to a rotor and called "propeller" attached to the motor car. The stator is not laid continuously along the

line, but is divided into sections, spaced at certain distances apart. The train receives a constant pull, since the length of the propeller equals the distance between the axis of two stator blocks. Moreover, to avoid energy losses in those stator parts not utilized at the time for propulsion purposes, switching arrangements are provided by means of which only that section of stator blocks is supplied with current over which the train is passing. According to circumstances, a section is composed of one or more stator blocks. In the latter case, each of the three windings of the one block is connected in series with the corresponding windings of the next, and at the distant end of each section the three windings are short-circuited by a switch as the train enters the section. This switch is operated by a small low-voltage three-phase motor, the rails, which are insulated from one another and also in sections, acting as conductors for the rotor circuit. Since the stator of the switch motor is continually fed with current, the rotor will commence to actuate the switch as soon as its circuit is closed by a train entering the section. It is said that by reason of the low voltage in the rotor no special insulation of the rails is required. After the train has passed on to another section the switch opens automatically by means of a counter weight. Fig. 5 shows the section through the propeller and stator block, the right-hand wheel being cut off from the illustration. The stator block is 9 ft. long and 1 ft. 8 in. wide over the pole tips. The pole core has a section of 10 in. by 6¼ in. Altogether there are 24 coils, that is 8 per phase, and they are wound by copper wire 0.1 in. diameter. Current is fed to the winding at a pressure of between 1,300 and 2,000 volts. The propeller has a length of 60 ft., which is about equal to that of the two-bogie cars employed in the tests. The stator blocks were spaced over 18 meters. The propeller is composed of 12 bars, each 5 ft. 1 in. long, which are mechanically, electrically and magnetically connected by means of flexible joints. A squirrel-cage type of winding is adopted for the propeller, which, like the stator, is fitted with laminated pole shoes. For starting, however, the resistance P is inserted in the squirrel-cage winding. A device is fitted to the propeller by means of which the air-gap may be varied, but it seems impossible to make it less than 0.4 in. An experimental line of ¼ mile has been equipped by this system.—From *Bull. Inst. Montefiore, in Lond. Elec.*, January 29.

REFERENCES.

Vienna.—An illustrated description of the municipal railway system of Vienna which, completed, will consist of about 350 km of track. The bow trolley system is used except in the center, where the underground conduit system is employed. The cars which operate in the center of the city are furnished with two plows, one on each side, with wings which fold up so that they can be lowered into the conduit. The power station is in two parts, one originally built for lighting and the other for railway work, although the two are now operated in conjunction. The coal consumption in October, 1902, was 1.117 kg per kw-hour. The engines in the larger power station are five in number, of 3,400 normal and 4,200 maximum hp, and operate three-phase alternators.—*St. R'y Jour.*, February 6.

Indianapolis & Northwestern Traction System.—An article on this interurban line. The main power plant comprises two steam-driven three-phase generators of 800-kw capacity. Current is delivered at 370 to 400 volts to the rotary converters in the power station, which are used to feed the trolley lines near the station. The remainder of the current is taken by three 300-kw step-up transformers which raise the voltage to 2,600, at which it is transmitted to the sub-stations for distribution. A statistical note states that the mileage of the interurban lines radiating from Indianapolis increased during 1903 nearly 100 per cent., not considering several large projects now under construction.—*St. R'y Jour.*, January 23.

Single-Phase Traction Motor.—See the above description of the Eichberg-Winter motor under Dynamos, Motors, etc.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Station Statistics of Great Britain.—A supplement to Lond. *Elec.*, January 8, gives a large table of all the electrical central stations in the United Kingdom with no tramway road. Very full information on the equipment is given in about 50 columns. There are in all 264 stations in operation, and 24 in progress of construction. A supplement to Lond. *Elec.*, January 25, contains a table of those central stations which supply current for both lighting and traction. There are in the whole 98 such stations. In an editorial on this subject it is said that when arc lamps of the Bremer and "flame" type made their appearance it was expected that they would revolutionize electric street lighting, but this has not been the case. The number of public arc lamps has remained nearly stationary. It is not expected that arc lamps will be largely employed for side street lighting. Nernst lamps have been extensively adopted, and it is said that for use on continuous current circuit they have established a good reputation, but there is room for considerable improvement in their behavior when worked by alternating currents (the Nernst lamps used in England are from the factory of the Allgem. El. Ges. in Berlin). In different parts of the country the motor connections have increased steadily, in some places even rapidly, the increase being greater for direct-current motors than for single-phase motors. Certain stations have adopted a tariff whereby energy is supplied for motive power at an extremely low rate, provided the consumer will refrain from taking current during "peak hours." Stepney and Brighton are cases in point; in these places a time switch is used, and, outside the prohibited hours, energy is supplied at a flat rate of 2 cents per unit. The number of undertakings "supplied in bulk" from power companies is largely on the increase.—Lond. *Elec.*, January 8.—Diagrams showing variations of the connections to the electricity supply works in London are given in Lond. *Elec.*, January 8; diagrams for the connections in London and in the provinces, in Lond. *Elec.*, January 15. There are also given some summary figures which apply to the aggregate connections to electric central stations, including power and tramway loads, but not including power supplied from purely tramway power houses . The total number of kw now connected in London is 167,640, and in the provinces 488,127, making a total of 655,767 kw in the United Kingdom. This shows an increase of 152,196 kw above the corresponding figure for December, 31, 1902. The equivalent of 8-cp lamps connected in the United Kingdom to date is nearly 22,000,000. The connections to stations under municipal control in both London and the provinces have increased out of all proportion to those under company control, and for the first time the former are now more than double the latter.—Lon. *Elec.*, January 15.

REFERENCES.

Compensated Potential Regulator for Single-Phase Current.—FLEISCHMANN AND EICHBERG.—An article illustrated by diagrams, in which the authors first discuss the disadvantages of the ordinary potential regulators for single-phase current, and then describe an improved form which, however, as Osnos remarks, appears to be identical with the induction regulator used by Lamme in his single-phase traction system. (*Elec World*, 1902, Vol. 40, October 4, page 538).—*Zeit. f. Elek.* (Vienna), January 10, 24.

Electric Installations on Board Ship.—LEBLOND.—The conclusion of his article in which he discusses the general requirements of electric installations on ships. In the present installment he deals with the prime movers to which the dynamos are directly coupled, and with speed regulation.—*L'Ind. Elec.*, January 25.

ELECTRO-PHYSICS AND MAGNETISM.

Radiations Emitted by Righi Vibrator.—WILLARD AND WOODMAN.—An illustrated description of experiments made to determine the nature of radiation emitted by a Righi vibrator and the dependence of the length of a linear receiver upon the wave length with which it is in resonance, and which was the subject of editorial comment last week. This problem resolved itself into the measurement of the energy received from the same vibrator by resonators of different lengths, and the measurement of the wave lengths obtained with different resonators. The measurement of energy with a linear receiver of definite length showed the existence of a fundamental and upper partials. The relation of the receiver lengths for the fundamental and the successive upper partials stand in the relation 1, 2, 3. The damping in the Righi vibrator is less than the theoretical value computed by Thomson for the radiation from a single sphere. The grating space of the separating surface does not affect the wave length measured.—*Phys. Rev.*, January.

Radioactivity.—BUMSTEAD AND WHEELER.—An account of the results of an experimental investigation of the properties of a radioactive gas found in the soil and water near New Haven, Conn. It is apparently identical with the emanation from radium. If any other radioactive constituent is present it can be only in very small proportion. The density of the radium emanating, as determined by its rate of diffusion, is about four times that of carbon dioxide. The authors were unable to obtain the radioactive gas from mer-

cury, recently described by Strutt, and are therefore inclined to attribute his results to an impurity in the mercury used.—*Am. Jour. Sc.*, February.

REFERENCES.

Magnetic Properties at Low Temperatures.—Honda and Shimizu.—An account of an experimental investigation of the magnetization and the magnetic variations of the length of ferromagnetic metals and alloys, especially nickel-steel, at the temperature of liquid air.—*Phys. Zeit.*, January 15.

Electro-Chemistry and Batteries.

Electrolytic Rectifier.—Cook.—An account of experiments made to find an explanation of the well-known behavior of the aluminium anode. He finds that the apparent resistance of the aluminium anode in potassium aluminium sulphate is not an ohmic resistance, but a resistance of the transition of the ions, primary or secondary. The formation of a film of alumina which is a very poor electric conductor, prevents the anions from reaching the conducting surface and thus discharging. When the electric pressure is greater than its "critical value" the film becomes crystalline in structure and in crystallizing exposes free metallic surfaces to the action of the anions, allowing them to discharge to the metallic surfaces. The value of the critical pressure and also the counter e.m.f depends upon the temperature. The critical electro-motive force for 1° C. is approximately 47 volts, and for 48° only 22 volts. The counter e.m.f. increases with decrease of temperature.—*Phys. Rev.*, January.

Units, Measurements and Instruments.

Bending of Magnetometer Bars.—Chree.—A paper on the source of error due to the bending of magnetometer deflection bars. In magnetometer measurements, the deflecting magnet is carried by the deflection bar at an appreciable height above the centre of gravity of the cross-section, and then bending of the bar when in use, under its own weight and that of the magnet with its carriage, results in an increase of the distance between the deflecting and the deflected magnets. To keep the instrument properly level, there ought to be a counterpoise on the other arm of the deflection bar at the same distance as the deflecting magnet from the centre. In the absence of such a counterpoise, supposing the instrument originally level, the weight of the magnet and carriage causes a slight tilting. In consequence of this the point of suspension of the deflected magnet moves toward the deflecting magnet, thus reducing the horizontal distance between them.—From *Phil. Mag.*, January, abstracted in Lond. *Elec.*, January 22.

Carbon Resistance.—Gray.—Longden has formerly shown how to make a fairly satisfactory high resistance by depositing soot on a plate of glass whose ends had previously been silvered with a wedge-shaped film. The present author substitutes a tube of glass for the plate. The ends after being silvered are wrapped with a ribbon of stout tin-foil, which is firmly bound on with copper wire so as to make good contact with the silver. Then the soot is deposited between the ends. The resistance tube is mounted on a block of paraffine and for the connections mercury cups are used.—*Phys. Rev.*, January.

Oscillator with Adjustable Capacity.—Castelli.—A description of an oscillator in which various systems of electric oscillations can be produced and their wave lengths can be varied continuously within wide limits. The primary and secondary plates consist of sheets of tin-foil suspended by pulleys and counterpoised so that they are at equilibrium at any level. They can also be slid forward or backward so that their distance apart and the amount of surface in direct opposition can be varied at will. In the course of his measurements with this oscillator, the author made an observation which he believes to be new. If a vacuum tube is used for discovering the nodes, and is gradually shifted beyond the node, it remains alight even in places where it would not light up if it approached it from the outside . The author compares this result with the fact that the distance between the carbons in an electric arc can be increased while the arc is playing to lengths at which an arc cannot be ordinarily formed.—From *Nuovo Cimento.*, July, August, abstracted in Lond. *Elec.*, January 22.

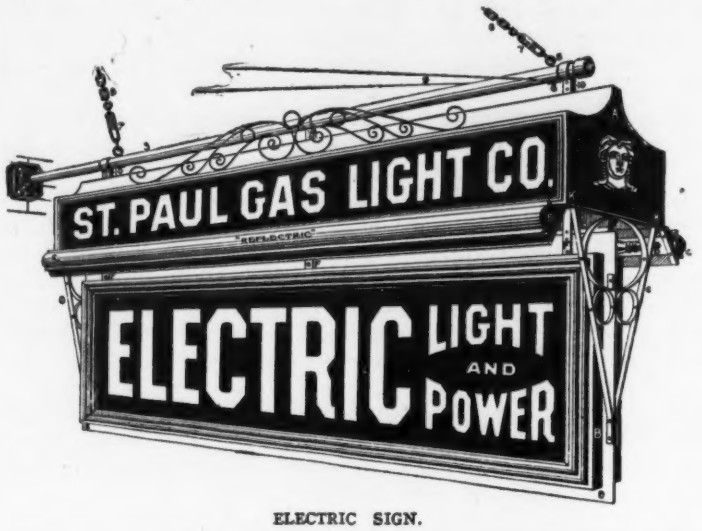
REFERENCES.

Magnetic Tests of Whole Sheets of Iron.—A fully illustrated description of the method of Richter, used by the Siemens & Halske Company for testing magnetic properties of iron sheets as a whole. The method has been noticed before in the Digest.—Lond. *Eng'ing*, January 29.

Electric Signs.

In giving a real brilliancy to frequented streets at night, the electric sign performs a service to the public, entirely aside from its utilitarian object, though in too many cases appreciation is blunted by inartistic forms and amateur construction, the full effect of which stands out clearly in the daytime. It is only recently that electric sign making has become an art, and before long we may expect to see the amateur sign maker wholly retired from the field. The accompanying illustration of a type of electric sign made by the Western Display Company, of St. Paul, Minn., shows what may be accomplished by inventive skill and making the most of the flexibility of the electric light, together with proper attention as to all mechanical details.

Instead of the ungainly box originating in the day when candles



ELECTRIC SIGN.

were the source of the illumination, the sign proper consists of two enameled plates on either side of a supporting metal frame. This construction, together with the enlarged top portion and the method of mounting produces an artistic effect recalling the pleasing signs of Old Paris. As will be noted, the lamps are mounted in a reflector from which the light is thrown with great brilliancy on the main display panels.

Above the main panels, which are of porcelain, is a glass panel on each side with white frosted transparent letters on a colored background, illuminated by transmitted light. The panels are interchangeable and can be removed without taking down the sign or disconnecting any wires. The wires for the electric lamps are encased in an iron channel and thoroughly protected from the weather. Both the transparent panel and the complete sign are free to swing.

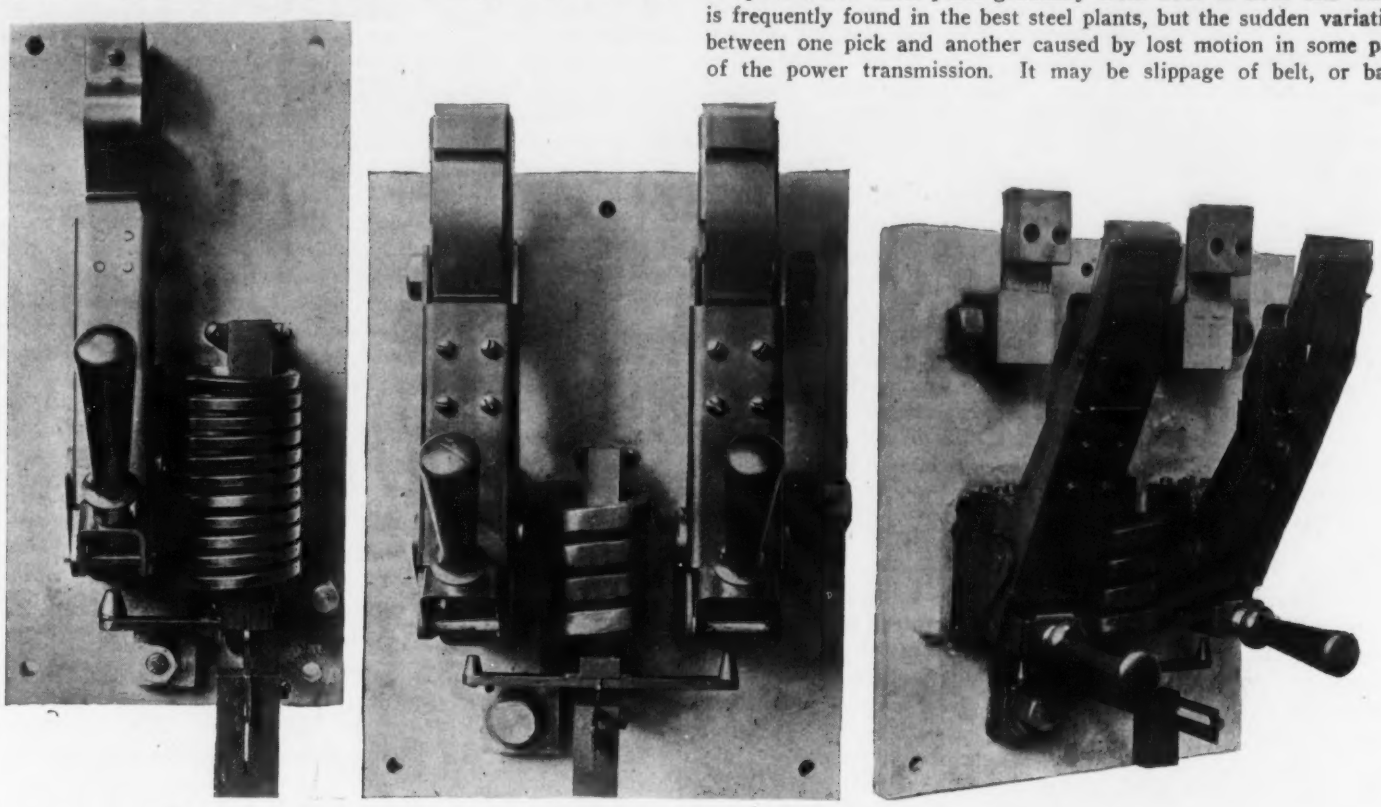
New Type of Carbon Break Circuit-Breaker.

The constantly growing demand for a high-grade automatic circuit-breaker to be sold at a popular price has led to a still further development of existing types by the Westinghouse Electric & Manufacturing Company, resulting in a new type (Type D) which we illustrate herewith. In this device the current is shunted to carbon arcing tips and there ruptured as in the original type of Westinghouse circuit-breaker. The single break is used and the construction is such as to gain the highest degree of efficiency from these and the other features employed.

The circuit-breaker is designed for use upon circuits not exceeding 250 volts, and its distinguishing feature is the simplicity of construction. As will be noted from the illustrations, there is no complicated or hidden mechanism, the entire device being open to inspection. It is small and compact, and thus occupies but little space. There are but few parts, and the most of these are made from punchings, combining strength, lightness and smoothly finished surfaces at a cost which enables the makers to adopt popular prices. There are no springs to get out of order, the only thing of this kind being

the flat strip which carries the carbon arcing tip and which also serves to throw back the movable arm when the breaker is opened. All screws are locked and the adjustments are few and permanent.

The movable contact is a laminated brush made from leaf copper and protected by a copper shunt, and so arranged that when the breaker is opened the current is shunted to the carbons above. The arc occurs when the final break is made on the carbons, the construction of the contacts aiding the natural tendency of the arc to rise and preventing it from being communicated to the other live parts. Flexible braided leads carry the current from the movable contact brush to the terminal, thus reducing the number of movable current-carrying contacts to a minimum. The temperature rise of the contacts is, in consequence, never over 20° C. with a normal current.



FIGS. 1, 2 AND 3.—CARBON-BREAK CIRCUIT-BREAKER.

The breaking mechanism is simple. The current passes through a coil through which is thrust one pole of a laminated iron horseshoe electromagnet. The armature is attached to the other pole of the magnet, and is so placed that a current sufficiently strong will draw up the free end of the armature, a movable counterpoise serving to vary the amount of current required. When the armature is drawn up contact points attached to it strike the toggle joints which hold the breaker closed and the circuit is opened. If desired, it can be opened by hand at any time, in the same manner as an ordinary switch.

The circuit-breaker is made with one, two, three or four poles, thus covering all the requirements for alternating-current and direct-current circuits. The single-pole breaker is particularly adapted for use upon motor or lighting circuits when a switch is used in series to complete the circuit after the breaker has been closed. In the two-pole breaker the two poles are closed independently. A switch to complete the circuit is not necessary, as the tripping mechanism is so designed that a short-circuit or an overload will cause the first pole closed to open immediately upon closing the other. This feature combines the functions of two devices at practically the cost of one with added convenience and saving of space.

The three-pole circuit-breaker for use upon three-wire direct current or three-phase alternating-current circuits, and the four-pole circuit-breaker for two-phase alternating-current circuit, are both so arranged that the poles are closed at the same time by the same handle and tripped simultaneously, either by hand or by tripping coils.

As regularly made, the circuit-breaker has front connections, as shown, but when desired for switchboard mounting a threaded copper stud for rear connections is substituted. It is neatly finished in black oxide and presents an attractive appearance.

Motors for a Silk Factory.

Every manufacturer of textiles knows the importance of constant speed in weaving. By this is not meant the slight variation in speed which takes place gradually from hour to hour and which is frequently found in the best steel plants, but the sudden variation between one pick and another caused by lost motion in some part of the power transmission. It may be slippage of belt, or back lash of counters, or many things combined; but the primary cause is that the machine using the power is so far away from its source, thus making its transmission necessary through many belts and counter shafts. In many cases the trouble is so bad that it almost prohibits the making of light weight goods. Many things are tried to overcome the trouble, and journals are tightened up until the loom will barely run, or speed is reduced, or more picks are put in. Any one of the three may partly correct the evil, but any one of them only adds to the cost of production. This is one reason why looms, especially those utilized in the manufacture of silk, both in broad goods and ribbon, are not driven at their maximum speed. Silk calls for the most extreme regularity of texture. Whatever

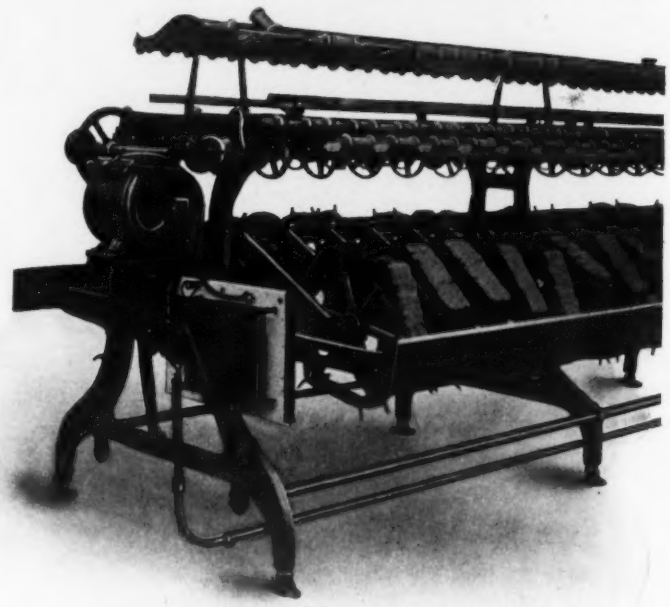


FIG. 1.—ELECTRICALLY-OPERATED SILK LOOM.

the quality of the goods, the beauty of the finished piece depends greatly on its evenness. To get this regularity, speed and production are sacrificed, because there is a limit at which a belt-driven loom can be run and make even work. If the limit is exceeded the momentum of the backward and forward motion of the lay is increased. The fly-wheel loses the control it has at a slow speed, and the blow of the lay becomes uneven, because the accelerated motion of the loom has also increased many fold whatever lost motion was in it before and "shirry" cloth is the result. In order to keep up the speed the plan is to put in more picks and so offer a better resisting medium to the blow of the lay, thus overcoming in a measure the defects. But this is wasteful. If we have a loom belted to the main shaft a higher speed can be obtained and better goods can be turned out than when the power is taken through many counter belts and shafts. All looms cannot be belted to main shafts, or, in other words, the power cannot be taken direct from its source, that is, from the engine to the loom. It cannot be done by belts, but it can be done by means of individual motors which seems especially adapted to the weaving of silks from the lightest to the heaviest fabrics. It might be thought too delicate a piece of mechanism to do the work; that the sudden jar caused by the banging off of the loom might wreck the motor; but it stands the strain under the severest tests even when geared up without the interposition of huffer springs.

As to gearing a motor direct to a loom: Some advocates of a belt connection between motor and loom say that it is necessary to act in a manner as an absorbent of the momentum, so that when the loom stops suddenly the elasticity of the belt and the slippage of the pulley inside it will prevent any jar to the motor. Others who favor belt connection are the makers of motors, who wish to connect the motor up without trouble. It is claimed that is one reason why so many failures have been made in electrically driven looms. Instead of an electrician looking into the matter and adapting his motor to textile requirements, he insists on putting in a motor which, however well adapted it may be to run a fan, sewing

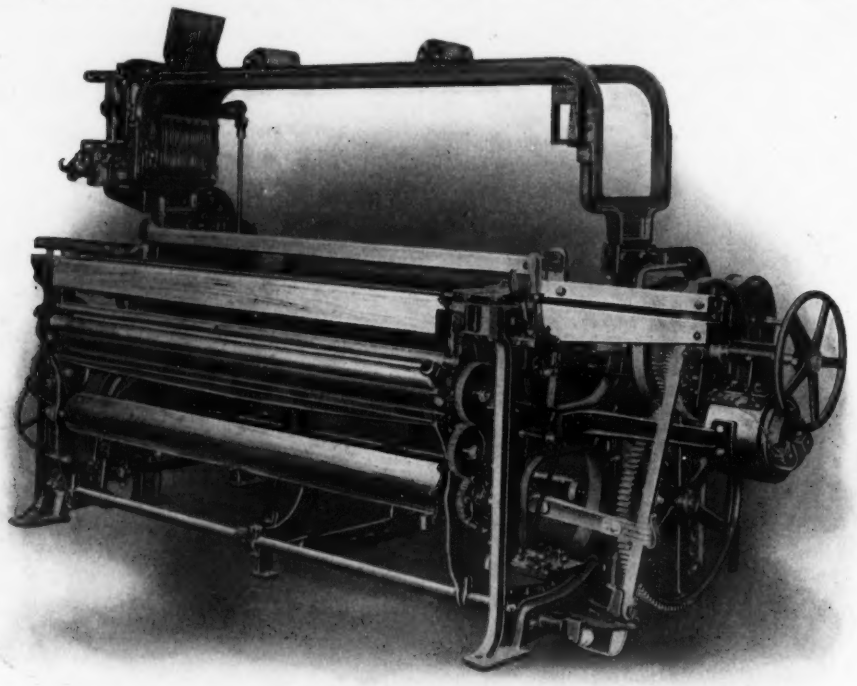


FIG. 2.—ELECTRICALLY-OPERATED SILK LOOM.

machine or lathe, is not suitable to put on a loom. The mechanical electrical requirements of a motor for a broad silk loom are many. First it must be made to gear into the loom by means of a steel pinion. Then the motor must stop when the loom is stopped. The motor stops the loom in the same way that the motor starts it—by throwing the current on or off—with no secondary motion by throwing out or in a clutch and then the current. Another thing necessary is that the motor starts at full speed instantly, for where a loom holds a flying shuttle, it is absolutely necessary to start at full speed in order to drive the shuttle across and into the box with just the right force and it will not do to have it start too quickly and consequently give too much force to the blow of the picking stick.

It is a great advantage also to have three speeds to a motor—the normal speed at which the loom is built to run, and say 12½ per cent. over and under. The motor should be light enough not to be cumbersome and yet strong. It should be directly attached to the loom and not to the floor. It should have plenty of reserve force behind it, so as to prevent it from unduly heating up when running, and that it may run equally well at a high or low speed. The higher the speed of course the more poweer is required from the motor and it also requires a reserve power in order to adapt it to the different fabrics woven in the same loom. At one time it may be a light taffeta requiring but very little power, while at other times a heavy brocade is being handled which would task the motor much more.

The silk factory at Andover, N. Y., owned by the Rochambeau Silk Company, has recently been installed throughout with motors directly connected to the looms, warpers and winders. This is the only silk plant in the country that is completely operated by direct-connected motors. The Northern Engineering Company secured the contract. There are 60 motors in all. They are ½-hp standard loom motors built by Roth Brothers & Co., of Chicago, Ill., and direct connected to Crompton-Knowles looms. The generating plant consists of a 50-hp Nash gas engine, vertical self-contained three-cylinder enclosed type, direct-connected to a 30-kw, 110-volt, 250-r.p.m. generator, built by the Commercial Electric Company of Indianapolis, Ind.

Nernst Lamp Company's Training School.

The Nernst Lamp Company will henceforth adopt the policy of establishing district offices in the larger cities of the United States and will deal directly with its trade through these branch offices, thereby resulting in a closer relationship between the manufacturer and the user. Each district office will carry a complete stock of the company's product and be in a position to give prompt attention to all orders received from its territory.

In carrying out these plans, the company finds it necessary to increase its selling force and will soon add to its staff a number of additional salesmen.

To increase the efficiency of its representative and other employees of the sales department, the Nernst Lamp Company have organized an "apprenticeship course" embracing a period of six weeks' time, during which time the apprentice will receive a nominal salary amply sufficient to pay all necessary personal expenses. The first two weeks will constitute a probationary period and will be spent in the nearest office of the company to which application is made, under the supervision of the district manager. While here the apprentice will have the opportunity of noting the methods employed by his tutor and assisting the latter in the discharge of his field and office duties. The remainder of the course will be given in the company's factory at Pittsburg, the third and fourth weeks being devoted to a detailed study of the mechanical and electrical features of the Nernst lamp, and the proper conditions and methods involved in its installation. This portion of the course will be concluded with a written examination on the work thus far encompassed. The fifth and sixth weeks will be spent in the study of maintenance and sales department systems and in practical work, in the maintenance and repairing of lamps, in the preparation of lighting plans, estimates, etc., and in actual soliciting under the tutelage of an experienced salesman.

Having completed the regular course to the satisfaction of his employers, the apprentice will be given a certificate to that effect and sent either to one of the branch offices where he will at once assume the duties of salesman or maintenance man under the supervision of the district sales manager, or to the Nernst lamp department of one of the company's central station customers. It is expected that the central station trade will constitute the bulk of the future business of the Nernst Lamp Company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was unfavorably affected by the hostilities in the East, the Baltimore fire and fears of extensive liquidation of securities by insurance companies. There was little public interest of a sepculative character and professional operators were bearish. One of the features of the market was the sustained strength shown by the United States Steel issues, which tended to advance in the face of the early weakness and held fairly well during the later depression, seeming to be the objects of a certain amount of short covering and of fresh accumulation. A good deal was heard regarding the probability that large contracts would be placed for the steel structural material required by Baltimore, and it was also claimed that the corporation will display large export sales this month, and that a readjustment of steel rail prices will be satisfactorily arranged with the railroads. There was some manipulative activity in Brooklyn Rapid Transit and other issues, but they did not attract any general attention. The curb market was heavy throughout the week with evident efforts by insiders of various corporations to realize on their holdings. Greene Copper sagged in connection with the new stock issue so that the rights became of slight value. The market for electric and traction stocks was in the main weak, closing at lower prices. American Telephone and Telegraph ruled at 123, closing at that figure, which was a net loss of 3 points. Western Union lost ⅝ point, closing at 87⅛. Brooklyn Rapid Transit was the exception and made a net gain of 2⅜ points, closing at 42¾ after having reached 43½. Metropolitan Street Railway fluctuated between 115 and 118, closing at 117½. General Electric lost 4 points on the week's business, closing at 166, after having reached 169. The closing figure was but one point above the lowest of the week. Westinghouse common closed at 160¼. Following are the closing quotations of February 16:

NEW YORK.

	Feb. 9	Feb. 16		Feb. 9	Feb. 16
American Tel. & Cable	82	81	General Electric	167	166
American Tel. & Tel.	124	120¾	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Metropolitan St. Ry.	117¼	118
Brooklyn Rapid Transit	41	43⅝	N. E. Elec. Veh. Trns.	..	..
Commercial Cable	183	193	N. Y. & N. J. Tel.	..	..
Electric Boat	17	17	Marconi Tel.	..	..
Electric Boat pfd.	40	42	Western Union Tel.	87¼	87⅛
Electric Lead Reduction	1	¾	Westinghouse com.	161⅛	160¼
Electric Vehicle	9	8¾	Westinghouse pfd.	175	175
Electric Vehicle pfd.	13	11⅞			

BOSTON.

	Feb. 9	Feb. 16		Feb. 9	Feb. 16
American Tel. & Tel	124	120¾	Western Tel. & Tel. pfd.	81*	80
Cumberland Telephone	114⅛	114⅛	Mexican Telephone	1¾	1⅝
Edison Elec. Illum.	236	232	New England Telephone	120⅛	119
General Electric	167	165	Mass. Elec. Ry.	20⅛	20⅛
Western Tel. & Tel.	10*	9	Mass. Elec. Ry. pfd.	77	77

PHILADELPHIA.

	Feb. 9	Feb. 16		Feb. 9	Feb. 16
American Railways	44	..	Phila. Traction	97⅛	..
Elec. Storage Battery	50	..	Phila. Electric	6	..
Elec. Storage Battery pfd.	50	..	Phila. Rapid Trans.	15¾	..
Elec. Co. of America	7⅛	..			

CHICAGO.

	Feb. 9	Feb. 16		Feb. 9	Feb. 16
Central Union Tel.	..	..	National Carbon pfd.	94	95
Chicago Edison	..	..	Metropolitan Elev. com.	17	17
Chicago City Ry.	166	162	Union Traction	5	4½
Chicago Tel. Co.	..	..	Union Traction pfd.	29	29¼
National Carbon	28*	27½			

*Asked

EVERETT-MOORE TELEPHONE.—The creditors' claims against the Everett-Moore Telephone properties represented in the companies controlled by the Federal Telephone Company amount to about $3,500,000. Recently these creditors agreed to an eighteen months' extension of credit. It is stated that in the meantime these obligations are being funded, creditors being asked to take collateral trust bonds of the telephone properties. It is thought that this collateral will be marketable at the expiration of the period at a figure that will cancel all obligations. The bankers' committee still has charge of all Everett-Moore affairs, which are in the hands of an executive sub-committee. It seems improbable that the bankers' committee will be relieved short of the time stated. The Everett-Moore security holdings are all held by the bankers' committee, or rather subject to their order, as nearly all of it is hypothecated for loans in local banks. In the present state of the security market, the holdings would liquidate at a price that would leave the syndicate bankrupt, probably to the amount of the telephone indebtedness. Under favorable monetary conditions the syndicate could probably wind up within a year and come out a little ahead, but the bankers' syndicate has done so well that there is little likelihood of sacrificing values in order to make a clean-up. The expectation is that within a reasonable time all obligations will be so funded on the basis of marketable securities, so that in time the syndicate holdings will be released largely intact and representative of a handsome equity.

NEW YORK INTERBOROUGH.—The Interborough Rapid Transit statement covering operations of the Manhattan elevated lines for the quarter ending December 31, shows the best results in Manhattan's history. As compared with the corresponding period in 1902, the following increases are shown: Gross earnings increased 13.9 per cent.; net earnings increased 21.8 per cent., and surplus after charges increased 65.5 per cent. The item of charges which includes, besides interest and taxes, the dividend on Manhattan stock appears to have been swelled to some extent by the inclusion of certain sums in connection with the adjustment of some tax claims, but for the settlement of which the final surplus might have been somewhat larger. It is understood that the statement presented might have been made to look much more favorable were it not considered good policy to foster a very conservative view as to the real earning capacity of the property. A less "conservative" statement might have the effect of renewing the labor agitation which broke out among the company's employes more than once last year. The gross for the quarter was $3,657,709 and the the net was $2,261,314. The gross for the nine months was $9,868,249 and the net was $5,862,144.

COMMERCIAL CABLE STOCK.—Note is made of the recent advance in Commercial Cable. Business has been good, and the war makes it better by the demand for news. The Postal Company, owned by the Commercial, has just completed 550 miles of line between Omaha and Denver, giving it a third route a large portion of the way across the continent to handle the increase in business caused by the extension of the cable from Honolulu to Manila, which affords connection with China, Japan and the Far East. Upon the completion of this cable July 4 last, the rate from China and Japan was reduced from $2 to $1.12 per word from New York, and the press rate from $1 to 50c. per word. As a result of war this cable service will be employed largely by the press of the United States and Great Britain, as better time can be made this way across America for England, than by the Suez Canal.

BELL TELEPHONE REQUIREMENTS.—A leading Boston interest in the American Telephone and Telegraph Company says: "The American Telephone and Telegraph Company will this year need $20,000,000, but it may not need this money until the fall, although the company generally raises its money in July. It may be that the company will this year issue convertible 5 per cent. bonds, although the president recently informed me that this subject had never been given consideration. It may be considered better policy for the American Company to become a borrower of money this year than issue new securities if market conditions are not better next summer, than at present. The American Telephone and Telegraph Company may use a portion of a new capital issue this year for the acquirements of certain independent companies which it can secure at an equitable price." The statement comes from Boston that it is the intention of the American Telephone and Telegraph Company directors to issue some time within the next four or five months $15,000,000 in bonds. President Fish is now in California and is expected to return about April 1. After that the matter will probably be taken up for consideration. Nothing has been determined upon as to the rate of interest the bonds will carry. That matter will be decided probably by the money market. Some talk has been heard regarding convertible bonds, but nothing beyond the fact that $15,000,000 will be needed has as yet been determined upon.

WISCONSIN CONSOLIDATION.—The Construction Company of North America, of New York, has secured control of one of the most important interurban railways in Wisconsin. The company has been building the interurban line from Sheboygan to Plymouth, and the new power house of the Sheboygan Light, Power, and Railway Company, and with the securing of control will come the transfer to the New Yorkers of the local electric system as well. The properties are worth about $1,000,000, but the importance of the deal is in the fact that this road will be the vital link in the proposed line from Fond du Lac to Kaukauna, forty-five miles in length.

CAPITAL TRACTION CO., of Washington, D. C., reports gross of $1,413,312 for 1903, and net $822,374; charges and taxes, $114,187,

dividends, $600,000. After various provisions for construction, equipment, etc., the surplus December 31 was $31,678.

DIVIDEND.—The Kings County Electric Light, Heat and Power Company has declared the regular quarterly dividend of 2 per cent.

Commercial Intelligence.

THE WEEK IN TRADE.—A summary of trade reports from the various sections of the country shows that temporary irregularities exist, due largely to the continued cold weather. The Baltimore fire and the war in the East have also affected trade more or less. In the West the cold weather checks spring trade expansion, but in the leading Eastern markets there is some activity. In the South distribution continues active. The great fire in Baltimore and the hostilities between Russia and Japan have affected the speculative markets to some extent, and the strength of prices in many commodities is attributed to the latter development. Conservatism in industrial operations is the rule. Money is easy and the banking situation is a very strong one as regards supplies of liquid capital, but currency has ceased to flow from the country, and with enlargement of activities in all lines a firmer market is looked for. Railway operations are showing decreased gross earnings, due to the severe weather of January, following reduced net earnings in December. Building operations in Baltimore will naturally develop a large inquiry for structural and building material. Country buyers are increasing in number at Chicago, St. Louis and Kansas City, and reports from these centers indicate that a good spring trade is anticipated. In the Northwest dullness prevails owing to the cold weather, but a fair business is being booked. In the Duluth district, lumber mill operations are active. Trade is improving on the Pacific Coast, with special activity in war supplies. The iron trade is irregular, but the railroads have begun to buy. Other metals are dull. Copper was further reduced in price, and the market was very weak. The official quotations of the Metal Exchange were marked down another ⅛c., the closing figures being 12¼ to 12½c. for Lake; 12⅛ to 12⅜c. for electrolytic, and 12 to 12¼c. for casting stock. The London market is also down. *Bradstreet's* reports 202 business failures for the five days ending Feb. 22, against 216 the week previous and 217 the corresponding week last year.

NEW TELEPHONE SYSTEM FOR MEXICO CITY.—The construction of an extensive up-to-date Yankee telephone system is contemplated in Mexico City. S. G. McMeen, a Chicago telephone expert, is now in the capital of the Southern republic making a study of the field and mapping the results as a final preliminary to the digging of the trenches and the laying of the conduit and cable. The cables in the underground section of the city will be laid in terra cotta conduit at a depth of about three feet from the surface. At distances of every 500 feet, manholes will be placed so as to facilitate repairs to the cables. The weight of the cables will be about six pounds per running foot. A new central station will be constructed. The visual signal system will be employed. Plans and specifications are now in process of being drawn up, and it is expected that contracts will be awarded within the next few weeks.

THE INTERNATIONAL TELEPHONE MFG. CO. of Chicago recently closed a contract with the Kansas Telephone and Electric Company of Parsons, Kan., for a complete new central office equipment consisting of a 1,000-capacity, 600-equipped, mechanical self-restoring dropboard and protective devices, also 200 International telephones. The board is the International Company's latest design and is equipped with flash light transfers, pilot lamps in connection with both the line and clearing-out signals, and is thoroughly up-to-date in every respect. The International Company states that during the past 90 days it has secured orders for switchboards aggregating over 6,000 drops equipped, and has recently found it necessary to increase its capacity to take care of the growing demand for its product.

JANUARY FOREIGN TRADE.—The statement of international trade for January showed a large balance in favor of the United States. This was expected in view of the high prices for cotton and breadstuffs in connection with the tendency for imports to decrease. The balance of trade in favor of the United States in January was $59,044,000, being $10,226,000 in excess of January, 1903, and $9,038,000 in excess of 1902. The imports of merchandise in January decreased $2,505,000 as compared with January, 1903. For the seven months ended January 31 the balance of trade in our favor amounts to $363,399,000, being $104,932,225 over the same period in 1903, and $16,747,000 over the corresponding period in 1902.

ACQUIRES SULZER PUMP PATENTS.—The International Steam Pump Company recently acquired the rights to manufacture the high-lift centrifugal pumps constructed by Sulzer Brothers, of Winterthur, Switzerland. After considerable experimental work, the company has produced a pump which is claimed to be so far an improvement over the ordinary centrifugal pump that heads up to 2,000 feet may be overcome with high efficiency. These pumps will be manufactured on an extensive scale at the new Worthington Works at Harrison, N. J. Numerous contracts have already been secured for equipments to be operated by motors.

ELECTRIC TRACTION FOR VERA CRUZ.—The construction of an extensive electric traction system in Vera Cruz, Mexico, is projected. The present horse tramways in that part of the world are about 11 miles long. They are controlled by the British contracting firm of S. Pearson & Son, who have large harbor and railroad construction contracts in hand in various parts of the republic. Sir Weetman D. Pearson is president of the Vera Cruz Company. In addition to converting the existing lines to electric motive power, it is proposed to extend the system considerably.

BLOCK SIGNALS FOR MISSOURI PACIFIC.—The Missouri Pacific Railroad has contracted with the Union Switch and Signal Company for the installation of an electrical automatic block system on all its main line tracks. Work will be begun at once on the 283 miles between Kansas City and St. Louis. Signals will also be put in on the first 165 miles of track on the Iron Mountain Road out of St. Louis, and on the line between St. Louis and Poplar Bluff by May 1. The system will then be gradually extended to the other lines of the Missouri Pacific.

EQUIPMENT FOR RAILROAD SHOPS.—The firm of Mackenzie, Quarrier & Ferguson, Engineering Building, New York, has secured a contract from the Australian General Electric Company—which is the Antipodean branch of the General Electric Company—for a 150-hp Harrisburg standard simple engine; also an 80-hp one. Both engines are to be belted to General Electric generators of 85-kw and 50-kw capacity each. The equipment, it is understood, will be installed in New South Wales government railroad shops.

NILES CRANES FOR BALDT STEEL PLANT.—The Baldt Steel Company, which is constructing a large plant at Newcastle, Del., to be equipped with considerable electrical machinery, has awarded a contract to the Niles-Bement-Pond Company, 136 Liberty Street, New York, for the electric overhead traveling cranes to be installed. There will be five equipments, varying in capacity from 10 tons to 30 tons. Jeremiah J. Kennedy, 52 Broadway, New York, is acting as consulting engineer to the Baldt Company.

ALBERGER CONDENSER FOR WESTERN PLANTS.—The Alberger Condenser Company, White Building, New York, has just taken two substantial Western contracts for its specialties. The Economy Light and Power Company, of Joliet, Ill., have ordered a high-vacuum condensing equipment. A similar equipment, also a cooling tower, is to be installed in the plant of the United Gas and Electric Company, of New Albany, Ind.

LIGHTING A PASSENGER STEAMER.—The large passenger steamer, the "City of Buffalo," is now being lengthened at the Detroit Ship Building Co., Detroit, Mich., and an increase in the electric light plant is being made by the addition of a 90-hp direct-connected unit. The Western Electric Co., Chicago, will furnish the generator, and the Ball Engine Co., Erie, Pa., the engine.

SALE OF SECOND-HAND ENGINES.—The engines of the Eightieth Street power station of the New York Edison Company have been sold to the Whitehead Machinery Company of Davenport, Ia. The equipment consists of two 300-hp simple condensing and four 900-hp tandem compound condensing Hamilton Corliss engines.

EDISON'S STORAGE BATTERY IN ENGLAND.—Thomas A. Edison's new storage battery is to be placed on the British market. A strong syndicate, headed by Sir Ernest Cassel, and in which H. F. Parshall, the well-known American electrical expert, is interested, will float a company for the purpose of acquiring the British rights.

LEFFEL WHEELS FOR 3,000-HP PLOW-MAKING PLANT.—The Oliver Chilled Plow Company is to install a large electrical equipment for the purpose of operating its plant at South Bend, Ind. About 3,000 hp will be developed by means of water. James Leffel & Co. secured the contract for the wheels.

EQUIPMENT FOR MEXICAN PAINT FACTORY.—Extensive paint and color works located at Irapuato, Mexico, are to be entirely operated by electricity. Steam power is employed at present. Ricardo A. Barkley is the proprietor of the works.

EQUIPMENT FOR MEXICAN FLOUR MILLS.—Large flour mills located at Irapuato, and owned by F. J. Randall, of that Mexican city, are to be electrically operated throughout, and contracts will be awarded for the necessary equipment.

PLUMBAGO IMPORTATIONS.—Figures from McCullough-Dalzell Crucible Company show importations into the United States from Ceylon in 1903, of 44,013 barrels of plumbago in lump, chip, dust, etc.

General News.

THE TELEPHONE.

CONWAY, ARK.—The Conway Telephone Company has been chartered, with a capital stock of $10,000. L. H. Pyle is president; F. E. Perminter, vice-president, and Gussie E. Pyle, secretary and treasurer.

LOS ANGELES, CAL.—The Home Telephone Company is considering the advisability of advancing its commercial rate from $4 to $5 a month.

SAN DIEGO, CAL.—The Home Telephone Company has paid $300 for a franchise to operate in this city. A plant costing at least $120,000 is promised. Long distance communication with outside cities has been arranged through the United States Telegraph & Telephone Company.

LOS ANGELES, CAL.—The stockholders of the Pomona Valley Mutual Telegraph & Telephone Company have voted a $20,000 bond issue, bearing 6 per cent. interest. The money thus raised is being used for construction purposes. The company has contracts for 500 telephones, 400 of which have been installed.

HARRISON, IDA.—The Interstate Telephone Company is installing many telephones here, in active competition with the Bell Company.

HARRISONVILLE, ILL.—The Harrisonville Telephone Company has increased its capital from $20,000 to $30,000.

KNIGHTSTOWN, IND.—About 125 representatives of independent telephone systems met at New Castle and perfected a permanent organization by electing O. H. Garriott, of Cadiz, president.

INDIANAPOLIS, IND.—The Cynthianne Telephone Company has filed articles of incorporation. The capital stock is $3000. John T. Arnett, U. C. Canada and Floyd Whitsel are the incorporators. The principal office will be in Cynthianne.

VELPEN, IND.—The Velpen Home Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $5000. The company will build and operate in Pike and Dubois counties with principal exchange and office in Velpen. L. R. Bradwell, W. S. Risley, A. S. Morgan and others are the incorporators.

SHELBYVILLE, IND.—The Mutual Telephone Company is establishing a rural exchange in Sugar Creek Township, another in Van Buren township and a third system in the neighborhood of London and Boggstown. In addition to connecting up these rural lines the company expects to erect a line west on the Marietta pike connecting a number of residences.

CUMBERLAND, IND.—The Cumberland Telephone Company, of this city, is preparing to make important and extensive improvements. The concern was organized over a year ago, with a capitalization of $10,000. The officers are: William Gale, president; F. W. Weise, secretary. A new exchange will be built in Cumberland, and considerable money will be expended in extending the lines to supply the large demand for service.

NEW CASTLE, IND.—The officials of the 14 independent telephone companies in Henry County held a meeting on February 1, and effected an organization for the purpose of co-operation, the exchange of service, mutual benefit, to encourage the extension of lines and to unite in an effort to fight competition introduced by the Central Union people. Dr. Garrett, of Cadiz, was made president, and George Watts, of Knightstown, secretary.

WABASH, IND.—The Central Union Telephone Company, which has been operating here without a franchise for the past four months, has made formal application for a franchise. The council directed the city clerk to notify the company that unless the officials sign and accept the franchise offered to the company some time ago, the city authorities would begin the removal of all poles and wires in the streets and alleys. It is generally believed that the company will accept the franchise as it stands.

SHELBYVILLE, IND.—The Central Union Telephone Company has perfected plans for the rebuilding of all its outside construction and installing a new switchboard. The new switchboard equipment will be of the central energy type of the Western Electric Company. It is the purpose of the management to extend the use of the telephone to every town, no matter how small, throughout the entire Shelby County, and at all places to put telephones in at the most reasonable rates consistent with good service.

RICHMOND, IND.—The annual meeting of the Richmond Home Telephone Company was held February 2, and the following persons elected directors: E. H. Cates, Samuel Dickenson, J. W. Moore, J. M. Lontz, A. C. Lindemuth, L. M. Flesh and W. P. Orr. The present officers were re-elected, including A. C. Lindemuth as president. The company has enjoyed a remarkably prosperous year. Four hundred and nine new telephones were installed during the year, making the total present number 1971. It is expected that the 2000 mark will be reached soon.

AUGUSTA, ME.—The Plymouth Telephone Company has been organized at Plymouth, with a capital stock of $10,000. The officers are: President, A. O. Ward, of Plymouth; treasurer, W. G. Loud, of Plymouth.

WAVERLY, MINN.—The Wright County Telephone Company has been incorporated with a capital stock of $50,000. The directors are G. W. Jennings, C. E. Wright and others.

MEXICO, MO.—A meeting of telephone managers will be held to devise a plan to have all of the lines in Audrain County meet at a central point, probably in this city. J. N. Rosser, of Rush Hill, president of a company forming for the construction of a line from this city to Laddonia, is the promoter of the project.

MIDDLETOWN, N. Y.—The new officers of the Orange & Sussex Independent Telephone Company recently elected are as follows: President, George G. Otis, of Newburgh; vice-president, George F. Ketcham, of Warwick; secretary, M. C. Tuthill, of Washingtonville; treasurer, W. D. Haggerty, of Sussex.

OSWEGO, N. Y.—The City Council has granted a franchise to the Empire State Telephone & Telegraph Company to construct a subway for its wires and cables in West Bridge Street and West Second Street of this city.

LIBERTY CENTER, OHIO.—The Farmers' Mutual Telephone Company has been organized, with A. C. Clinton, president. The company will build a farmers' system.

CRESTLINE, OHIO.—The Bell Telephone Company is making an effort to secure a new franchise in Crestline. Some years ago it secured a franchise, but did not build.

NORWOOD, OHIO.—The Norwood Citizens' Telephone Company has applied for a franchise and will probably secure the grant. At present the Bell Company holds the field.

WESTON, OHIO.—The Weston Telephone Company has elected S. A. Murphy, president: G. B. Spencer, treasurer. The company reports a good gain during the past year.

URBANA, OHIO.—The United States Telephone Company has completed a line between Urbana and Springfield, and the Urbana Telephone Company is now giving long distance connection with all points south of the city.

MT. PLEASANT, OHIO.—The Mt. Pleasant Telephone Company, capital stock $5000, has been incorporated by J. M. Bennett, J. A. McGlenn, Michael Gallagher, C. P. McMillan and E. B. Jones. An exchange will be built at Mt. Pleasant.

PAINESVILLE, OHIO.—The Painesville Telephone Company has elected F. A. Searl, president; W. R. Radcliff, treasurer, and C. M. Grauel, secretary and manager. The company made a good gain during the year, and has recently installed a new switchboard.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has elected Frank Hart, president; J. W. Shoneher, secretary; F. W. Whitaker, treasurer, and A. B. Crawford, general manager. The company has about 1500 telephones in operation and is making rapid gains.

BRYAN, OHIO.—O. L. Spanger has been appointed general manager of the Bryan Consolidated Telephone Company, which has recently absorbed the Williams County Toll Line Company and the Bryan Telephone Company. The company is planning numerous extensions this year.

CANTON, OHIO.—The Stark County Telephone Company has elected F. S. Dickson, president; R. W. Judd, treasurer, and A. S. Hillhouse, secretary and general manager. The company is planning to extend its lines throughout the county, and will install several exchanges in small towns.

CONNEAUT, OHIO.—E. S. Barber and J. S. Brailey, of Wauseon, who built the Conneaut Telephone Company's system, have retired from the management of that company, and J. G. Palmer has been appointed manager. The company now has 676 telephones, an increase of 24 during the year. It will make improvements this year.

BELLEVUE, OHIO.—The Local Telephone Company has elected C. R. Callaghan, president and general manager; Frank Knapp, secretary, and J. H. Beatty, treasurer. The company owns exchanges in Bellevue, Norwalk, Chicago Junction, Berlin Heights, Greenwich, Monroeville, Plymouth, Milan, New London and Attica, and has over 200 miles of toll lines. It has 2300 telephones in service, and with improvements planned for it is expected the number will soon reach 3000.

CINCINNATI, OHIO.—The City Council has refused the various applications for independent franchises in the city, and all the applicants have applied to the probate court under the law which provides that companies may appeal to the probate court in case the application has been refused by the Council. The four competing independent companies are the Queen City Telephone Company, the Fitzsimmons Telephone Company, the Interstate Telephone Company and the Cincinnati Telephone Company.

COLUMBUS, OHIO.—Several bills of interest to telephone people have been introduced in the Ohio Legislature. Representative Ely, of Ashland County, has a bill to compel rival telephone companies to make concessions so that subscribers on one line may talk to subscribers on the other line on payment of a fixed toll. The bill provides that the connection must be made by the company desiring the connection. Representative Judy, of Darke County, has a bill limiting telephone rentals in all cities to $6 per month for business telephones and $3 per month for residences. This applies to old as well as new companies.

SCRANTON, PA.—The Pennsylvania Telephone Company is improving its service in this city and will expend $200,000 in the work. The improvements will include the installation of a new switchboard.

HUNTINGTON, W. VA.—The Bell interests have obtained control of the Ohio Valley Telephone Company, which has lines extending from Huntington to Pomeroy, Ohio.

BARABOO, WIS.—The Baraboo Telephone Company has amended its articles of incorporation in order to increase its capital stock from $30,000 to $50,000.

LARAMIE, WYO.—The Rambler Telephone Company will build a line from this city a distance of 18 miles to Tie Siding, where the line will be connected with an extension of a telephone line from Fort Collins, thus giving communication with northern Colorado towns.

OTTAWA, ONT.—Mr. Frank J. Leonard, general manager of the Canadian Telephone and Telegraph Company has written to the city clerk of Toronto, Ont., that his company is ready to do business with the city on the following basis: "Business telephones at a yearly rental of $36, residences at $24. We will pay to the city for competitive franchise the same fee that the Bell Telephone Company has been paying for exclusive privileges. We will build a conduit system through the principal streets of Toronto, as may be required by city ordinance, or, in case the city would build its own conduit system, we agree to lease ducts in said system, sufficient for our business at such rental as may hereafter be decided upon."

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation, which maintains 820 miles of high-potential transmission lines and branches, exclusive of distributing systems in cities, lost only three insulators during the first 37 days of 1904. Locke insulators are used largely, and 40,000 volts is carried.

SAN FRANCISCO, CAL.—The Northern California Power Company will soon erect a three-story brick and stone building in Redding, Cal., for a general headquarters for the company, which operates about 100 miles of electric transmission lines. Supplies will be carried, and an electric repair shop will be located in the basement.

SANTA ROSA, CAL.—A committee of the City Council of Santa Rosa has received a report from Thomas Merk, of the Engineering Offices. He estimates that it would cost $30,000 to install a municipal plant to generate current for 100 arc lights, using steam from the city water works station. His figure on a plant to supply 6000 incandescent lights was $50,000.

SAN FRANCISCO, CAL.—The Mutual Electric Light & Power Company, of San Francisco, has filed the following report of its business for the year 1903: The total receipts were $115,051.94, including $114,788.20 from light and power. The expenditures were: General expenses, $25,975.23; manufacturing, $58,106.12; distribution $11,202.12; total, $95,283.47. The original cost of the plant is placed at $519,993, but its present value is said to be unknown. The capitalization is $500,000, and 41,000 of the 50,000 shares have been issued. A $400,000 bond issue has been authorized, but the bonds have not yet been sold. The floating debt outside of that portion covered by cash on hand, outstanding accounts and collectible assessments, amounts to $58,447.99. Two 1500-kw three-phase generators, with engines which are to be direct connected, are on the ground and will be installed as soon as arrangements are completed for commencing the new power station.

SAN FRANCISCO, CAL.—The American River Electric Company, of which Mortimer Fleishhacker, of San Francisco, is president, is now supplying the city of Stockton, Cal., with current from its water power electric transmission system. Commercial light and power circuits are included. The first 1500-kw Westinghouse 3-phase generator has been in operation or several weeks, lighting Placerville and operating a 250-hp gold dredge at Jenny Lind. The plant is on the American River near Placerville. A second 1500-kw generating unit is ready for operation, and it is the intention of the company to order a third unit which will probably be installed before the end of this year. The Folsom Development Company's large gold dredge at Folsom, Cal., is now receiving power from the American River Electric Company. The first dredge was recently completed, a second is in course of construction and a third will be commenced soon. It is estimated that ten gold dredges will be in operation in the vicinity of Folsom within a year. The American River Company established a record for rapid electric construction work on the Coast in building this plant and about 100 miles of pole line between May, 1903, and January, 1904.

WASHINGTON, D. C.—The National Light, Heat and Power Company has been incorporated by P. H. Kennedy, H. E. Warren and C. D. Wright; capital, $500,000.

WASHINGTON, D. C.—The Pan-American Electric Light & Power Company has been incorporated with a capital stock of $1,000,000. The incorporators are: Morris Simon, Max R. Raubitschek, William I. Murphy, R. S. Donaldson, E. W. McCormick, S. A. Terry and others.

JEFFERSON, GA.—Judge H. W. Beal and Paul B. Matthews are considering the advisability of establishing an electric light plant and water works.

CHICAGO, ILL.—The Commonwealth Electric Company is stated to have purchased property adjoining its present works; the plant will be enlarged.

CICERO, IND.—The Town Board has taken steps toward the building and installation of an electric light plant.

TIPTON, IND.—It is reported that the municipal electric light plant is to be enlarged.

EAST CHICAGO, IND.—The Indiana Trust Company, receiver, has recommended that the equipment of the East Chicago electric light plant be improved.

FT. WAYNE, IND.—The City Council has adopted the report of the committee on contracts and franchises, recommending the passage of the ordinance granting the Jenney Light and Power Company a franchise.

AURORA, IND.—The City Council has notified the Aurora Gas & Electric Light Company to discontinue lighting the city after March 1, and to remove its poles and wires from the streets within 20 days after the expiration of the contract, March 1.

INDIANAPOLIS, IND.—The Indianapolis Board of Public Works will advertise for bids until February 25, for a 10-year contract for electric lighting of the city. The specifications call for 1600 arc lights of 2000 cp each and 500 incandescents of 50 cp each. G. E. Fisher, representing the Fidelity Construction Company, of Detroit, has surprised the board with a proposition to build a modern municipal lighting plant, to operate it for 10 years, and then sell it to the city at a merely nominal price.

MUSCOGEE, I. T.—The Muscogee light and power plant, ice plant and gas franchise have been sold to a Chicago syndicate. This plant was built and owned by C. W. Turner and was the first electric light plant built in Indian Territory. With the plant goes a gas franchise granted by the city to the company, and an agreement and bond to construct and operate it. The consideration was $125,000. The Chicago company will also build a street car system.

WALNUT, IA.—The City Council has adopted plans for a $14,000 electric light plant.

NEW ORLEANS, LA.—The charter of the New Electric Light Company has been approved by the City Council, and it has been authorized to do business in this city.

WORCESTER, MASS.—It is reported in financial circles in this city that a syndicate of capitalists has been organized to acquire control of the electric lighting and gas business throughout the western part of Worcester County, from Worcester to Palmer.

BENTON HARBOR, MICH.—The City Council has let a contract for lighting the city to the Benton Harbor & St. Joseph Electric Light Company. The company will supply 125 1200-cp arc lights at $47 per annum each, this being a reduction from $70 each.

KOOCHICHING, MINN.—The Village Council is calling for bids to install a municipal electric light plant.

STILLWATER, MINN.—It is reported that the Stillwater Gas and Electric Company will make surveys and plans for a new dam in connection with a power house. The work complete will cost $200,000.

CLINTON, MISS.—The citizens have voted to issue bonds for the construction of water works and an electric light plant.

ST. LOUIS, MO.—The Anheuser-Busch Brewing Association has contracted for two 200-kw turbo-generator units for its plant in this city.

STANBERRY, MO.—The Stanberry Electric Light Company has been incorporated with a capital stock of $25,000, all paid in. The incorporators are: James T. Norman, Alvin C. Frisbie and Thomas D. Hussey.

COLUMBIA, MO.—A special election has been called by the City Council to vote on the proposition to issue bonds for $100,000 for the purchase of the waterworks and the electric light plant belonging to the Columbia Water & Light Company. The plant has been appraised at $67,000 by a board of commissioners, and that amount will be paid for the plant, the remainder being used in installing a system of deep wells.

JERSEY CITY, N. J.—The Monterey Light & Power Company has been incorporated; capital, $500,000. Incorporators: Kenneth K. McLaren, Robert L. Hogust and Roger H. Williams.

JAMESTOWN, N. Y.—The Warren Electric and Manufacturing Company has secured the contract for machinery for the municipal electric light plant for $8000.

MOORESVILLE, N. C.—B. A. Troutman, of Mooresville, is the promoter of a stock company which expects to build an electric light plant in this town.

SALISBURY, N. C.—The Salisbury electric light and gas plants have been sold to the Salisbury-Spencer Light and Railway Company. The electric plant will be used in the operation of the street railway now under construction.

RICHWOOD, OHIO.—The Richwood Light, Heat & Power Company, capital $30,000, has been incorporated by O. P. Lenox, L. G. Peet, B. Cahill, J. F. Wood and L. P. Albright. The company will purchase the lighting plant now owned by E. A. Schambs, and will add to the equipment and extend the service.

COLUMBUS, OHIO.—The Indianola Heating & Lighting Company and the Public Service Company have agreed on a consolidation. The former operates a lighting and heating plant on the North Side, and the latter is building a similar plant on the West Side. The capital of the new company will be $1,500,000. A. W. Field, who has been manager of the Columbus Railway & Light Company, is slated for manager of the consolidated company.

GROVE CITY, PA.—J. W. Russell, Jr., Borough Secretary, writes that the borough will probably construct a municipal electric light plant.

WILKESBARRE, PA.—The City Council has granted franchises to the Ashley Electric Light Company and the West Side Electric Light Company.

NEW CASTLE, PA.—The town has decided to erect a municipal lighting plant, and contracts for material will be closed at once. At present the Mahoning Valley Railway Company lights the town.

NASHVILLE, TENN.—It is reported that Meikleham, Dunsmore & Ackerman, of New York, have agreed to take $2,000,000 of the stock and bonds of the Great Falls Power Company which, it is stated, will shortly begin the work of developing the Caney Fork falls near Nashville, where a minimum of 2000 hp is available. The concern proposes to supply power and light to many towns in central Tennessee.

WILLS' POINT, TEX.—The Wills' Point Electric Light Company has filed letters of incorporation, with a capital stock of $10,000. The incorporators are: O. I. Johnson, Charles E. Brown and W. B. Rogers.

NEWPORT NEWS, VA.—The Newport News Shipbuilding & Dry Dock Company contemplates the building of a plant for manufacturing electrical equipment for ships.

ELLENSBURG, WASH.—A special election has been held here, at which the citizens voted favorably upon the proposition of bonding the city for $20,000 for an electric power and lighting plant.

MONTICELLO, WIS.—E. L. Bables is reported interested in the construction of a lighting plant.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company has passed into the control of the Construction Company of America, which is building the interurban railway to Plymouth.

WHITEHALL, WIS.—As a result of the washing away of a portion of the mill-dam, this village is now without electric light. There are no prospects of resumption until warm weather sets in.

SHERBROOKE, QUE.—The Sherbrooke Heat, Light & Power Company has made a proposition to the Council of the city of Sherbrooke that if the company is granted a contract for 15 years, it will give a reduction on the flat rate of 16-cp lamps from $6 to $5, and an equal share of the net profits. It is expected that this proposition will be turned down, as the municipal ownership party claims that as the company is only able to pay 4 per cent. there would be little left for division. It is understood that if the electric company does not accept the city's offer of $200,000 for electric light and gas plants, that a company will be formed and electric light supplied the city at a minimum figure.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—The Mobile Light & Railroad Company will apply to the board of revenue of Mobile County for the right to extend the Whistler branch from Pritchard Station to Magazine Point.

BIRMINGHAM, ALA.—The annual meeting of the Birmingham Railway, Light & Power Company was held at the offices of the company in Birmingham. The officers now are: Robert Jemison, president; W. A. Walker and J. A. Emery, vice-presidents; J. P. Ross, secretary; C. O. Simpson, treasurer and auditor; J. A. Emery, general manager.

LOS ANGELES, CAL.—Abbot Kinney, who, with the old Los Angeles Traction Company, was engaged in building an electric railway from this city to Santa Monica in opposition to the Los Angeles-Pacific Railroad Company, has sold his interest to Gen. M. H. Sherman and E. P. Clark, of the Los Angeles-Pacific Company, for $280,000.

DENVER, COL.—Under a final decree issued by Judge Hallett, in the United States Court, all the holdings of the Denver, Lakewood & Golden Railway will be sold within 60 days for the benefit of creditors. There is due, according to the decree, to the holders of 627 outstanding bonds of the company, for principal and interest, the sum of $1,016,060, no part of which has been paid. The court has appointed a special master, who will take charge of the sale and report to the receiver and to the court.

NEW LONDON, CONN.—The Groton & Stonington Street Railway Company is perfecting arrangements for beginning the construction of its proposed road as soon as the weather moderates.

CHICAGO, ILL.—The Aurora, Elgin & Chicago Railway is about to issue second mortgage bonds to the amount of $500,000.

BELLEVILLE, ILL.—Attorney Charles A. Karch has received word from President J. R. Piercy and Chief Engineer Isaac C. Smith, of the Southern Illinois Electric Railway, which will build a line from Salem, Ill., to Belleville, where it will connect with the East St. Louis & Suburban, that they have been successful in disposing of their bonds to a New York firm, and that the work now under way will be pushed so as to have the lines in operation by July 1.

INDIANAPOLIS, IND.—The Marion County Construction Company, organized to construct and build electric and steam railroads, and other public works has increased its capital stock $25,000. C. E. Haugh is president and W. C. Smith, secretary.

COUNCIL BLUFFS, IA.—The City Council has voted to grant a franchise ordinance to the Council Bluffs, Tabor & Southern Electric Railway.

ARKANSAS CITY, KAN.—L. H. P. Northrup, who was given a franchise to build an electric railway in this city and an interurban road between Arkansas City and Winfield, and Arkansas City and Chilocco, has employed Thomas V. Hall & Company, consulting engineers, to survey the line.

HOPKINSVILLE, KY.—The Southern Kentucky Interurban & Traction Company is said to be contemplating the building of an electric railway from Hopkinsville to Franklin, Ky.

LEXINGTON, KY.—The plan of Cincinnati, Hamilton and other Ohio capital to construct an electric railway from Lexington, Ky., to Frankfort, Ky., a distance of some 30 miles, has been revived.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company is offering to float $250,000 5 per cent. first mortgage gold bonds, to be used in building into Louisville. The common stock of the company is $2,000,000 and the preferred stock is $1,000,000. The trustees of the new issue are the American Trust & Savings Bank, of Chicago, and the United States Trust Company, of Louisville.

BOSTON, MASS.—The Newton Street Railway Company has petitioned the railroad commissioners for authority to issue $250,000 5 per cent. coupon bonds, par value $500 each, the same to be used for additional extensions and equipment.

WORCESTER, MASS.—A petition has been filed in the State Legislature by the Worcester Consolidated Street Railway Company for authority to build an extension to its lines through West Boylston and Sterling, connecting Worcester and Leominister.

BOSTON, MASS.—The railroad commissioners have given their approval of the sale of the Framingham, Southboro & Marlboro Street Railway Company to the Boston & Worcester Street Railway Company, and have authorized the latter company to issue 1850 new shares to consummate the sale, the said new shares to be exchanged share for share for the capital stock of the Framingham, Southboro & Marlboro Street Railway.

DETROIT, MICH.—The Detroit United Railway Company will likely build an electric belt line to handle freight. The idea is to have an electric belt line upon which freight coming into Detroit can be handled, thus relieving the freight traffic on streets now crowded with passenger traffic.

TRENTON, N. J.—The Trenton Street Railway Company is installing an 800-kw generator in its power house. Additional boilers will be installed later, and the company proposes having practically a duplicate set of generating machinery, so that there will be little danger of a tie-up from accidents.

ALBANY, N. Y.—The Ithaca-Cortland Traction Company has been authorized to issue a mortgage for $650,000 for construction work.

ALBANY, N. Y.—The State Railroad Commission has given authority to the Central Long Island Electric Railway to issue a mortgage on its property for $500,000. It is proposed to build a line from Port Jefferson to Patchogue.

NIAGARA FALLS, N. Y.—The Electric City Railway Company has been incorporated to build a line eight miles long. The capital stock is $80,000 and the directors are Alvah K. Potter, Lockport; James S. Simmons and Frederick J. Brown, Niagara Falls.

NEW YORK, N. Y.—The Interborough Rapid Transit Company has ordered 200 steel cars for use in the subway. The cars will be delivered in the spring for use as soon as the road is opened to traffic. The new cars are to be 51 ft. 2 ins. long, including platforms, 12 ft. high from rail to roof, and 8 ft. 7 ins. wide over the sheathing. The interiors will have a aluminum finish. The seats will be of metal.

MARION, OHIO.—The Findlay, Forest & Marion Railway Company has been incorporated, with $10,000 capital stock, by Claude Meeker, Walter B. Beebee, H. E. Armbruster, M. B. Earnhart and William A. Morrison.

WARREN, OHIO.—The Warren, Cortland & Jefferson Traction Company has been incorporated, with a capital stock of $10,000. The incorporators are: John Lundy, P. N. Taylor, A. H. Gebert, J. L. Morgan and Geo. Pomeroy.

WILKESBARRE, PA.—There is talk of building a third-rail electric railway from White Haven to Wilkesbarre.

NEWHOPE, PA.—The Trenton, Newhope & Lambertville Street Railway Company has secured an option on the Newhope-Delaware Bridge, which is being constructed between this borough and the city of Lambertville, N. J. The company, which is connected with the New Jersey & Pennsylvania Traction Company and the Yardley, Morrisville & Trenton Street Railway Company, has a charter for a line from Yardley to this place, and it is understood that construction will begin in the spring.

LANGHORNE, PA.,—William B. Parry, who built the Newtown, Langhorne & Bristol Street Railway, and who has been actively interested in the movement to connect Philadelphia, Langhorne and Trenton by a direct electric railway, has secured rights of way over most of the route lying between Langhorne and Willow Grove. Private right of way has been secured, as far as possible, and the proposed line extends from this borough to Somerton, Philadelphia, thence to Bethayres, Alnwick Park, Heaton and Willow Grove, where connections would be made with the Philadelphia Rapid Transit lines for Philadelphia and Doylestown.

CORSICANA, TEX.—The Corsicana Traction Company has increased its capital stock from $100,000 to $125,000. It is reported that the company will make important improvements and will extend its system.

MEMPHIS, TENN.—The location of the line of the Shelby Traction Company of Memphis has been determined, and estimates are now being made for the construction of the twenty-mile line.

OGDEN, UTAH.—The La Porte Construction Company of La Porte, Ind., has been awarded the contract for the construction of the Burns-Bamberger road between Farmington and this city. The Salt Lake and Ogden Railway road extending from Salt Lake to Farmington will be converted into an electric system. The work is to be completed within ten months and will be commenced some time in March. About $5,000,000 will be expended on the proposed work.

NEWPORT NEWS, VA.—The directors of the Newport News & Old Point Railway & Electric Company have elected officers for the ensuing year as follows: President, William J. Payne; vice-president, Geo. A. Schmelz; treasurer, Henry A. L. Schmelz; secretary, D. C. Zollicoffer; general manager, H. H. Carr.

NORFOLK, VA.—Judge Waddill, in the United States Court, has granted the petition of the receivers of the Bay Shore Terminal Company to issue receivers' certificates to the amount of $150,000, which funds will be used by the company to complete its electric railway system through from the business parts of Norfolk to Ocean View.

DAVENPORT, WASH.—The Adams County Electric and Transit Company has decided to extend its system from this city to Crystal City, a distance of about twenty-six miles.

APPLETON, WIS.—W. H. Holcomb, J. A. Hayes, John L. Jacqet and Paul V. Cary have incorporated as the Outagamie Traction Company to build an electric railway between Appleton, Hortonville and other cities. The necessary franchises have nearly all been secured.

ROSSLAND, B. C.—MacDonald and Winn, of this place, are seeking incorporation for a company to build a line of electric railway from Crawford Bay on Kootenay Lake to a point near Fort Steele, East Kootenay district.

BRANTFORD, ONT.—Application will be made to the Parliament for a charter incorporating an electric railway from Thorold south to Port Colborne, east to Fort Erie, westerly through the counties of Welland and Haldimand to Brantford.

WALKERTOWN, ONT.—The Walkertown & Lucknow Railway Company is seeking incorporation to build a line of electric railway from this town to the village of Lucknow. A. H. Macdonald, of Guelph, is solicitor for the applicants.

GUELPH, ONT.—The Guelph Junction Railway Company will ask incorporation to build a line from Guelph to Goderich, with a branch to Listowel and another branch to St. Mary's and Clinton, via Stratford, with power to lease or sell to the Canadian Pacific Railway. Electric power will be used.

WINNIPEG, ONT.—Messrs. Campbell, Pitblado, Hoskin and Grundy, of Winnipeg, give notice of an application to the Manitoba Parliament for an act to incorporate a company to build and operate an electric railway and telegraph and telephone lines within a radius of 75 miles of Emerson, in the Province of Manitoba. Permission is also sought to construct and maintain a water power development on the Roseau River.

OTTAWA, ONT.—At the coming session of Dominion Parliament a company, in course of organization, will apply for a charter to construct an electric railway from Ottawa to Buckingham, thence up the Leivre River to a point on the line of the proposed Grand Trunk Pacific Railway, and on to James Bay. The names of those interested in this enterprise are withheld at present, but it is understood they comprise Ottawa and Montreal capitalists.

QUEBEC, QUE.—A project is under way to connect with the city of Quebec by means of an electric railway, a number of parishes surrounding that city. A company has been formed and application will be made to the Provincial Legislature for a charter. The capital of the new company will be placed at $100,000.

NEW INDUSTRIAL COMPANIES.

THE ALPHA COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $25,000, to construct power plants.

THE NATIONAL TELEPHONE CONSTRUCTION COMPANY has been incorporated at Chicago with a capital stock of $2500. The directors are E. J. Phillips, G. A. Herrick and others.

THE HARPER ELECTRICAL COMPANY, of Fort Wayne, Ind., has filed articles of incorporation. The company proposes to manufacture electrical supplies. Raymond and Joseph Harper and others are the promoters.

THE DRAWBAUGH PATENTS COMPANY has been incorporated in Jersey City, N. J., with a capital stock of $40,000. The incorporators are Leo J. Matty, Emilius W. Scherr and Herbert G. Ogden.

THE ELECTRIC BURGLAR ALARM & DEVICE COMPANY has been incorporated in Washington, D. C., with a capital stock of $60,000. The names of the incorporators are: G. M. Walker, J. E. Crandall and C. H. Neely.

THE MISSOURI AUTOMOBILE WORKS, St. Louis, Mo., with a capital stock of $10,000, one-half paid, has been incorporated. The shareholders are: Robert N. Collins, Christopher W. Johnson, Cyrus W. Haas, A. T. W. Pritchett and L. P. Graffmann.

THE GISSON-SHORT CYCLE AND AUTOMOBILE COMPANY, of Indianapolis, Ind., has incorporated with an initial capital of $10,000. This amount will be increased soon. The company will manufacture and sell automobiles, repair bicycles and automobiles, motor vehicles, etc. W. H. Brown, C. E. Short and C. E. Gibson are the incorporators.

THE STERLING ELECTRIC COMPANY, of Lafayette, Ind., has increased its capitalization $100,000. This money will be used for improving and enlarging the plant in order to take care of the company's rapidly increasing business. The officials deny the report that the company or plant is to be consolidated with Kellogg Switchboard and Supply Company, of Chicago.

LEGAL.

"HOW OLD IS ANN?"—"How old is Ann?" is a question that the Supreme Court of Virginia must decide. It came up recently at Richmond in the case of Northington vs. the Norfolk Railway & Light Company. The age of Miss Ann Northington, of Norfolk, when she signed a certain conveyance is in doubt. One side of the controversy contends that she was eighteen, while the other says she was twenty-three. When one of the attorneys stated that the proposition was "How old is Ann?" there was a burst of laughter, in which the court was compelled to join. It became apparent, however, that it was no joking matter, and that upon the decision of the court depends who will receive a large sum of money.

WAGNER MOTORS AND TRANSFORMERS.—Judge Adams, of the United States Circuit Court, St. Louis, handed down decisions in two important patent cases Saturday, February 13. One was the General Electric Company against the Wagner Electric Manufacturing Company, of St. Louis, for infringing a patent on electric motors. This was a motion for preliminary injunction. The court denied the injunction. The other case was brought by the Westinghouse Electric & Manufacturing Company against the Wagner Electric & Manufacturing Company, for manufacturing electrical transformers. Suit was brought on a patent granted to George Westinghouse, Jr. The court in this case decided that the transformer manufactured by the Wagner Company was no infringement of the patent sued on.

TELEPHONE AND EMINENT DOMAIN.—In Kirby vs. Citizens' Telephone Company of Sioux Falls, S. D., the question came up whether the erection of a telephone system in the streets of a city constituted an additional servitude. Upon appeal, the Supreme Court of South Dakota sustained the vacating of a preliminary injunction against the telephone company. Its points were: 1. Const. Art. 6, Sec. 13, providing that private property shall not be taken or damaged for public use without just compensation, and that the fee of land taken for highways shall remain in the owner, and Article 17, Sec. 18, providing that compensation shall be made before property is taken or injured, do not apply to the use of the streets of a city for the purposes for which they have been dedicated. 2. Under the direct provisions of Laws 1885, p. 208, c. 141, Sec. 3 (Rev. Civ. Code 1903, Sec. 554), a city may permit a telephone company to erect poles and maintain a telephone system on its streets. 3. The construction, maintenance, and operation of a telephone system on the streets of a city in such a manner as not to cause unnecessary injury or inconvenience to property owners is not an additional servitude for which an abutting owner is entitled to compensation.

ACCIDENT FROM CONDUIT WORK IN STREET.—The case of Leavitt vs. New England Telephone Company was settled recently by the Supreme Court of New Hampshire. In an action against the telephone company for injuries caused in passing over a sidewalk at a place where an excavation had been made by defendant, under license from the city, plaintiff's claim was that defendant was liable for the injuries without regard to the fact that the city had done part of the work of filling the excavation. Plaintiff offered no exceptions to the court's charge, but merely excepted to the admission of evidence in substantiation of the defendant's theory that, the city having completed the filling of the excavation, defendant was not liable. It was held on an appeal that plaintiff could not obtain a reversal on the theory that defendant's evidence was irrelevant, but should have excepted to the charge. The remarks of defendant's counsel to the effect that the concreting over the excavation was done for the city, and when defendant was stopped in its work by the superintendent of streets its liability ceased, furnished no ground for setting aside the verdict, as the statements of fact were supported by evidence, and the statements of law, if erroneous, would be deemed to have been corrected by instructions.

PERSONAL.

H. L. WEBB.

MR. HERBERT LAWS WEBB.—All the American friends of Mr. Herbert Laws Webb will be interested to know that after several years of residence in this country he has decided to take up his abode permanently in England, his native land. Mr. Webb has been connected with the development of electrical industries from his earliest youth, being a member of the well-known Webb family so prominent in submarine cable development in England in the last century, and one of whom was formerly secretary of the English Institution of Electrical Engineers. Mr. Webb is also a nephew of Sir W. H. Preece, F. R. S. As an electrical engineer Mr. Webb has been actively engaged in the practice of his profession since 1889, and before he came to the United States he had devoted his attention to submarine cable work. While in this country he gave his attention chiefly to telephonic development, although for a short period in 1892 he was editor of *Electricity* at the time that paper started. For several years past he was engaged as a member of the expert staff of the New York Telephone Company, for whom he made three trips to Europe on inspection work, as well as for the American Bell Telephone Company. For about a year past Mr. Webb has been in England as an expert connected with the Buckingham automatic telegraph system and in connection with telephonic work. In 1897 he gave evidence at the well-remembered Glasgow telephone inquiry and since that time has been called into other investigations of the same character. He is the author of an excellent guide to cable testing, etc., and of an admirable little telephone handbook which has had a wide circulation. To the electrical and general press and particularly to these columns, as well as to the magazines, he has contributed numerous articles on electrical subjects, chiefly of a telephonic nature. In resuming residence in London, Mr. Webb is making his headquarters at 8 Queen Anne's Gate, but he will shortly be moving into larger quarters where he will engage in the practice of consulting electrical engineer, giving special attention to telephonic work. The best wishes of his American friends follow him back to the old country, whither he returned during the last week or two.

MR. A. A. KNUDSON, the specialist on the subject, lectured before the Franklin Institute, Philadelphia, last week, on the corrosion of metals underground by electrolysis.

MR. W. H. BASSETT, of Jefferson City, Mo., has been appointed auditor and traffic manager of the Kinlock Telephone Company, of St. Louis, with headquarters at Jefferson City.

MR. P. LETHEULE, of the French Thomson-Houston Company, has been appointed by the French Government engineer of the French Department of Electricity at the St. Louis Exposition.

PROF. FRANK G. BAUM has resigned from the electrical engineering department of Stanford University to accept the post of electrical engineer for the California Gas & Electric Company, in connection with the Bays Counties and Valley transmission plants.

MR. LOUIS ALBERGER, of the Alberger Condenser Company, White Building, New York, who has been absent from his office for some three weeks past owing to indisposition, has gone for a trip to Cuba to look over the business situation in that part of the world.

MR. WILLIAM E. GAVIT has been elected vice-president of the old American Institute of New York, in whose spacious rooms and building the New York Electrical Society holds so many of its meetings. In this respect Mr. Gavit has been an active and influential friend of the Society.

MR. DOUGLASS BURNETT has been elected general manager of the United Electric Light & Power Company, of Baltimore, Md. Mr. Burnett has been identified with the New York Edison Company since 1894, and is a member of the American Institute of Electrical Engineers and of the New York Electrical Society.

MR. W. D. BALDWIN, president of the Otis Elevator Company, White Court Building, New York, has returned from a trip to Europe, whither he recently went in connection with the contract for the large passenger "lifts" to be installed in the London underground railroad system now being constructed by the Charles T. Yerkes syndicate.

MR. CAMERON FORBES, a member of an old Boston family well known in connection with Bell telephone history and development, and who has been prominently connected with the electrical firm of Stone & Webster since graduating at Harvard, has been offered by President Roosevelt an appointment as one of the commissioners for the Philippine Islands. He has accepted.

PRESIDENT H. S. PRITCHETT, of the Massachusetts Institute of Technology, while in Germany recently, spent some time studying the experimental electric road in the environs of Berlin upon which the uniform high speed of from 100 to 130 miles an hour is maintained. He will have an interesting account of his impressions in *McClure's Magazine* for March.

MR. J. H. WAUGH, of Pittsburg, Pa., has severed his connection with the Westinghouse Electric & Manufacturing Company and has assumed the active management of the business of the Electrical Equipment & Supply Company, of that city. This latter company has just been chartered under the laws of Pennsylvania, with a capital stock of $60,000. President Waugh is greatly encouraged as he starts out, business developing rapidly, with inquiries from all over the Union.

MR. JOHN F. KELLY, of the Stanley interests and president of the John F. Kelly Engineering Company, Singer Building, New York, has gone to

Milwaukee in connection with the development of the plans of the Allis-Chalmers Company, which concern, as mentioned in our last issue, is to enter into the manufacture of electrical machinery on an extensive scale.

MR. PUTNAM A. BATES, assistant secretary and sales manager of the Crocker-Wheeler Company, announces that he has resigned his position and will retire from that company on March 1 next. Mr. Bates has formed a partnership with Mr. John Neilson, who was until recently assistant secretary and assistant treasurer of the New York & Stamford Electric Railway, and under the firm name of Bates & Neilson, will conduct a general practice of consulting electrical engineering, with offices in New York City.

OBITUARY.

MR. ERASTUS WIMAN, of Staten Island, N. Y., died last week. He was at one time very active in electrical matters, especially telegraphy, and later on took up the development of electrical lighting with equal energy, establishing a large plant on Staten Island where he introduced also the alternating-current system for the streets. His electric fountain displays are well remembered by New Yorkers. Deceased was born in Churchville, Ont., in 1834.

H. W. OLIVER.—Mr. Henry W. Oliver, the well-known iron manufacturer of Pittsburg, died at Alleghany, Pa., on February 9, of a complication of diseases. Mr. Oliver was born in Ireland in 1840, and was brought to Pittsburg when two years of age. He began his business career as a messenger for the old National Telegraph Company at the age of 13, and ultimately became president of one of the largest iron and steel plants in the country. Mr. Oliver served in the Civil War, and throughout his life was active in politics.

M. A. HANNA.—Senator Marcus A. Hanna, of Ohio, died at Washington, February 15, of typhoid fever, after an illness extending over nearly two months. Deceased was one of the most widely known men in the United States, being prominent in national politics and in large business enterprises in Cleveland, which was his home. Senator Hanna was prominently identified with the street railway development in Cleveland, and at the time of his death was a director of the Cleveland Electric Railway Company. He was born in New Lisbon, O., September 24, 1837, and was consequently in the 67th year of his age. Special funeral services were held in the United States Senate chamber on Wednesday of this week, and the remains were afterwards taken to Cleveland for burial.

Trade Notes.

THE SPRAGUE ELECTRIC COMPANY has just issued a bulletin devoted to the W. L. engine type of direct-current generators, illustrating and describing them.

THE SPRAGUE ELECTRIC COMPANY announces that its Baltimore office, which was destroyed in the recent fire, is now located in the Maryland National Bank Building.

HADAWAY ELEC. HEATING & ENG. COMPANY, of New York City, announces that it has moved its offices to Room 322, No. 136 Liberty St. It has doubled its shop capacity, and is now able to take care of a large business.

CROCKER-WHEELER COMPANY, of Ampere, N. J., announces that its Chicago office has established headquarters for Western Ohio, at No. 1232 Union Trust Building, Cincinnati, O., with Mr. H. A. Brown as representative.

THE ELECTRIC PORCELAIN COMPANY, East Liverpool, O., has planned to make an addition to its already large plant, to cost $16,000. This extension is necessary in order to supply the rapidly growing demand for this company's goods.

THE ELECTRIC STORAGE BATTERY COMPANY.—Owing to the fire in Baltimore, the Electric Storage Battery Company has removed its Baltimore office to Philadelphia, and until further notice it will be at the headquarters, Allegheny Avenue and Nineteenth Street.

THE DOWNWARD LIGHT ELECTRIC COMPANY, 225 Fourth Ave., New York, has found its increasing business so widespread that it has been deemed advisable to open a branch office in Philadelphia. This is located in the Witherspoon Bldg.

C. & C. ELECTRIC COMPANY, 143 Liberty St., New York, has recently issued several bulletins, both quite voluminous, one giving a list of some users of its various generators and motors, and the other being devoted to illustrations and description, etc., of its "M. P." machines, direct-current, so well and widely known. Applications of the apparatus are shown, as well as details of construction.

ELECTRICAL MATERIAL COMPANY, of Baltimore, Md., informs us that it was fortunate enough to escape damage direct, from the recent great fire. Under the circumstances, it now looks naturally for a very large increase in business, and has decided to more than double its stock to take care of the in-rush of orders. It is now in a better position than ever to make immediate shipments.

THE NERNST LAMP COMPANY, in accordance with its new policy of establishing district offices in the large cities, has recently opened an office at 47 State St., Detroit, Mich., and appointed Mr. Charles F. Case as district sales manager of it. The territory embraced by this office is the lower peninsula of the State of Michigan, the northwestern part of Ohio and the northeastern part of Indiana.

VIADUCT MANUFACTURING COMPANY.—We are glad to note that the great fire at Baltimore, Md., did not reach the offices of the Viaduct Manufacturing Company, of that city, whose factory, being located ten miles out at Relay, is also still in full blast, turning out large quantities of telephones, district messenger boxes, Skirrow switchboards, resonators, etc. All orders are being attended to with prompt dispatch.

THE REEVES ENGINE COMPANY, New York, whose product has met with such phenomenal success, is now in a position to entertain establishing selling agencies throughout the United States and foreign countries. Its manufacturing facilities have been so materially increased that it is able to make prompt deliveries, and will be pleased to hear from capable people desiring to avail themselves of this excellent opportunity. Its sales office is at 85 Liberty St., New York.

THE "TALKING" SIGN.—The Mason Monogram Company, 280 Broadway, New York, has issued a unique card regarding its electric "talking" signs. The card contains a night view of a store over which is one of these signs. In the card is a slit, under which a circular card is moved about its centre. On being turned words are brought under the slot, reproducing the effects of the actual sign. It is an excellent idea and shows in very compact form just how these signs produce the results claimed for them. The utility of the card is made greater by the addition of a neat little monthly calendar attached to one corner.

TURBINE ENGINEERING COMPANY.—This concern, of West Troy, N. Y., and Whitehall Building, Battery Place, New York, calls attention to its hydraulic power department at the former address. It acts as engineer and contractor for complete hydraulic power plants, and states that its relations with the manufacturers of the equipment used in such plants is of a character that places it in a peculiarly advantageous position for carrying out such work. It takes the contract for the entire plant, with all the consequent benefits to the purchaser dealt with. The officers are: A. M. Young, president; H. G. Runkle, vice-president; M. J. Warner, treasurer; F. A. Curtiss, secretary; L. G. Read, general manager; J. Sturgess, manager of the hydraulic department.

EUREKA TEMPERED COPPER.—The Eureka Tempered Copper Works, North East, Pa., have just issued their 1904 catalogue and price list of their copper and brass products for all purposes. The list is a very complete one and includes commutator bars and commutators for machines of all the standard makes; trolley harps; trolley wheels; brushes; switches, etc., a code word being given for each size and make. Besides this there are several tables of value in making calculations and estimates. At the back of the book are several numbered pages perforated, which are to be torn out and replaced by sheets of corresponding numbers when received from the works. The catalogue is gotten up in an excellent manner, and is well illustrated. It shows great painstaking and care in its production. The Eureka works are among the oldest in the business, and their long experience has placed the concern in a position to produce the best goods possible.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 9, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

750,309. ANNUNCIATOR; Lambert Schmidt, Weehawken, N. J. App. filed Aug. 28, 1901. (See page 365.)

751,440. COMMUTATOR LEAD AND MODE OF MAKING SAME; Charles F. Adams, Pittsfield, Mass. App. filed Aug. 8, 1903. A flat copper strip is folded lengthwise and slit along the fold at one end so that the members may be bowed outward to embrace the conductor, the opposite end going into the commutator bar.

751,441. MEANS FOR PROTECTION AGAINST REVERSE CURRENTS; Leonard Andrews, Manchester, England. App. filed June 25, 1903. Two magnetic circuits are energized respectively by a shunt and a series winding, two secondary windings are arranged to be excited by the magnetic circuits and to operate a circuit-controlling magnet.

751,442. REVERSE CURRENT CUT-OUT; Leonard Andrews, Manchester, England. App. filed June 25, 1903. A closed magnetic circuit carrying two coils and an open magnetic circuit shunting both parts of the closed circuit on which said coils are wound, the open circuit including a reciprocating member which actuates a switch.

751,459. LINE INSULATOR; Cummings C. Chesney, Pittsfield, Mass. App. filed Jan. 14, 1903. An H-shaped insulating support composed of a plurality of insulators set at an angle to each other.

751,460. LIGHTNING ARRESTER; Cummings C. Chesney, Pittsfield, Mass. App. filed Aug. 8, 1903. The earth wire includes a solenoid coil and an air gap, the latter being opened by the energizing of the coil.

751,474. POLE CHANGER FOR DYNAMOS; Isidor Deutsch, Montreal, Canada. App. filed May 14, 1903. Details.

751,501. ELECTRIC TELEPHONE; Ernst Gundlach, Western Springs, Ill. App. filed Nov. 10, 1902. (See page 365.)

751,527. APPARATUS FOR DIVIDING, SEVERING AND SIMILARLY TREATING CLOTH; Alexander Marr, Manchester, England. App. filed June 5, 1903. Electrically heated wires are arranged upon the surface of a drum, and the drum rolled over the cloth to sever it along lines corresponding to the position of the wires.

751,539. RINGING-KEY FOR TELEPHONE-SWITCHBOARDS; Frank R. McBerty, Evanston, Ill. App. filed May 9, 1902. (See page 365.)

751,547. MOTOR CONTROLLER; Francis V. Nichols, Pittsfield, Mass. App. filed June 13, 1903. Improvements directed towards reduction in size and simplicity.

751,549. SYSTEM OF ELECTRICAL DISTRIBUTION; John S. Peck, Pittsburg, Pa. App. filed May 1, 1903. A plurality of compound-wound rotary converters adapted for operation in parallel, a bank of transformers each having a plurality of secondary windings so arranged that the number of rotary converters connected thereto may be varied without varying the compounding effect upon the direct-current circuit supplied thereby.

751,563. DYNAMO ELECTRIC MACHINE; David B. Rushmore, Pittsfield, Mass. App. filed June 26, 1903. The internal shape of the field coil is different from the external shape of the core which it surrounds, to produce ventilating spaces.

751,566. RINGING-KEY FOR TELEPHONE-SWITCHBOARDS; Charles E. Scribner, Chicago, Ill. App. filed May 9, 1902. (See page 365.)

751,571. TIME LIMIT RELAY FOR ELECTRIC CIRCUITS; Harve R. Stuart and Arthur B. Reynders, Wilkesbarre, Pa. App. filed April 11, 1903. A time limit relay for electric circuits, comprising two contact members, mechanical devices for operating one of them to close the relay circuit, electro-magnetic devices for releasing that member, a retarding device and means for varying the length of the path through which the movable member travels.

751,574. ELECTRIC SPARK-PRODUCING APPARATUS; Chester H. Thordarson, Chicago, Ill. App. filed March 10, 1903. Details of construction of a vibrator wherein the breaking of the circuit is accomplished by a sharp hammer-blow, the force of which may be adjusted.

751,581. CONTROLLING MECHANISM FOR ELECTRIC VEHICLES; Frank S. Wahl, Buffalo, N. Y. App. filed Dec. 21, 1901. Details.

751,595. PARALLEL FEEDER PROTECTION; Leonard Wilson, Pittsfield, Mass. App. filed July 16, 1903. A plurality of parallel feeders and a choke coil for each feeder having one winding energized by the current in its feeder and a second winding opposing the first and energized by the sum of the currents in all the feeders.

751,597. ELECTRIC SWITCH; Gilbert Wright and Harold C. White, Pittsfield, Mass. App. filed June 13, 1903. Details of a quick-acting switch.

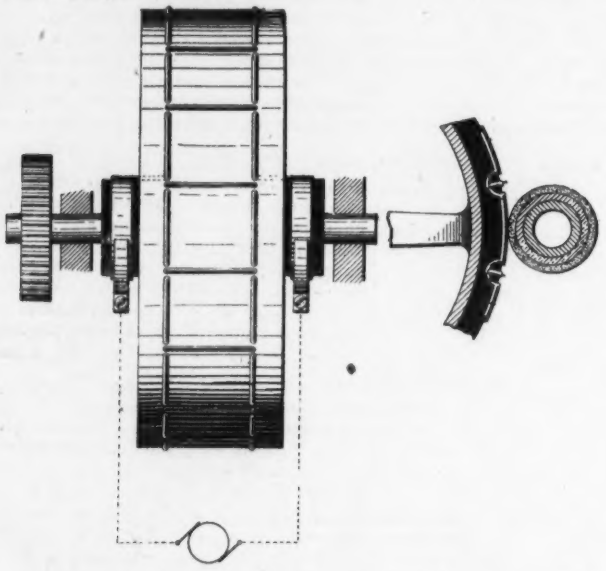
751,598. MEANS FOR CONTROLLING GOVERNOR MOTORS; Gilbert Wright, Pittsfield, Mass. App. filed Sept. 24, 1903. A switch consisting of a handle mounted upon the end of spring plates arranged mid-way between two sets of contacts, so that by hand-manipulation the center plates can be thrown to one side or the other and held as long as desired to impart a corresponding rotary impulse in one direction or the other to a motor.

751,616. MAGNETO-ELECTRIC GENERATOR; Hugh J. Creighton, Anderson, Ind. App. filed May 13, 1903. The magneto is mounted on a base in a manner to yield when inaccuracies of strain occur in the belt.

751,634. RHEOSTAT; George Graybill and John P. Oden, York, Pa. App. filed June 8, 1903. A rheostat for lamp sockets consisting of a rod projecting more or less into a body of granular resistance.

751,638. ATTACHMENT FOR COTTON SEED LINTERS; John W. Harrington, Eastpoint, Ga. App. filed May 2, 1903. A magnetic plate arranged in the throat of the machine to remove bits of iron that may be carried in the body of seeds.

751,654. APPARATUS FOR THE REGULATION OF ELECTRICAL CIRCUITS IN HEATING DEVICES; Willie D. Kilroy, Uxbridge, England. App. filed Oct. 6, 1902. A combined plug and socket operating as a switch in various angular positions.



751,527.—Apparatus for Dividing, Severing and Similarly Treating Cloth.

751,655. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 9, 1901. (See page 365.)

751,664. ELECTRIC INSULATOR; Thomas T. Lyman, Montclair, N. J. App. filed April 4, 1902. An insulator to prevent the formation of electric arcs, composed of asbestos, plaster-of-paris and silicate of soda, vitrified and coated with a waterproofing solution.

751,728. ROTARY SNAP ELECTRIC SWITCH; Monroe Guett, Hartford, Conn. App. filed Sept. 23, 1903. Details.

751,739. INSULATOR; Peter S. Lindal, Edinburg, Pa. App. filed March 31, 1903. Glass plates between which the conductor is held are placed in a box and clamped together by a screw.

751,743. INSULATOR; Joseph M. Mahoney, Boston, Mass. App. filed Dec. 1, 1902. A two-part sleeve having interlocking connections.

751,745. AUTOMATIC SWITCH; Morris Moskowitz, New York, N. Y. App. filed April 8, 1903. Details of a pole-changing switch especially applicable for train-lighting systems in which the generator is subject to frequent reversals in direction of rotation.

751,749. TROLLEY WHEEL; John E. Palmer, Somerville, Mass. App. filed Nov. 14, 1903. Means for retaining the wheel on the wire.

751,750. INDICATING MEANS FOR SNAP ELECTRIC SWITCHES; Charles G. Perkins, Hartford, Conn. App. filed Oct. 29, 1903. A dial supported by and adapted to be rotated on the outside of the cover of the switch.

751,760. ELECTRIC SIGNALING APPARATUS; John E. Stannard, Springfield, Mass. App. filed Feb. 2, 1903. Details.

751,772. STORAGE-BATTERY PLATE; Charles B. Askew, Chicago, Ill. App. filed May 20, 1903.

751,777. FLEXIBLE CONDUIT; Archibald T. Blackler, Malden, Mass. App. filed March 14, 1903. An insulating conduit consisting of a helix composed of smooth, flexible, compact, insulating material, longitudinal strips of a similar character interwoven and one or more longitudinal locking threads.

751,780. ELECTRIC SIGNAL; Harold E. Bradley, Warwick, R. I. App. filed Oct. 3, 1903. The invention comprises the specific devices used in a block system wherein a signal set by one car as it enters the block, is not returned until the last of any number of cars which may also have entered, has passed out.

751,788. ELECTRIC SIGNAL APPARATUS; John M. Golding, Washington, D. C. App. filed July 15, 1903. Means whereby a person desiring to signal another at a different point, may close an electric circuit including the signal at the distant point, which closure will at the same time lock an indicator, which will remain locked until the circuit is broken at the distant point, to notify the sender of the signal that the same has been received.

751,797. CENTRAL-ENERGY TELEPHONE SYSTEM; John Henry Lendi, Chicago, Ill. App. filed Dec. 19, 1900. (See page 365.)

751,803. WIRELESS ELECTRIC APPARATUS ACTING ON TYPE-WRITERS; Giuseppe Musso S. Angelo Dei Lombardi, Italy. App. filed Sept. 23, 1902. The electric waves are used to command two disks rotating synchronously at the communicating stations and which are connected with keys of typewriters.

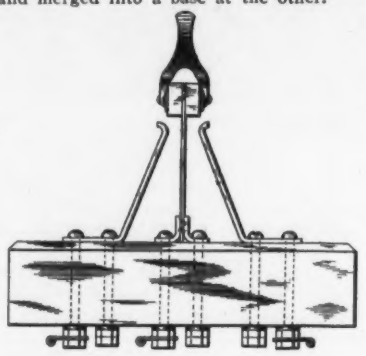
751,816. PROCESS OF WINDING; Arthur J. Strong, Dayton, O. App. filed May 15, 1903. A method of winding wire upon a closed ring.

751,818. ELECTRICALLY-PRODUCED-SOUND INTENSIFIER; Gustaf T. Swenson, San Pedro, Cal. App. filed Dec. 17, 1902. (See page 365.)

751,829. TELEPHONE; Ernest Theodore Billig, New York, N. Y. App. filed Dec. 2, 1902. (See page 365.)

751,830. ARC PREVENTER; Charles E. Blood, Fitchburg, Mass. App. filed Oct. 14, 1903. Air pipes leading to the contacts of the controller are closed and opened at the proper time by the movements of the controller.

751,831. INSULATOR PIN; James H. Bullard, Springfield, Mass. App. filed Aug. 8, 1903. A metal insulator pin comprising a series of webs united near one end and merged into a base at the other.



751,598.—Means for Controlling Governor Motors.

751,839. ELECTRIC HAIR BRUSH; Henry C. Doersch, Nyack, N. Y. App. filed June 1, 1903. Details.

751,854. THERMOSTAT; George D. Hoffman, Chicago, Ill. App. filed May 25, 1903. Details.

751,857. SYSTEM OF ELECTRICAL PROPULSION; Erich Krause, Hoboken, N. J. App. filed Oct. 22, 1903. Solenoids arranged in line with each other and supporting internal rails, cause an armature or car riding upon the rails to be drawn through them.

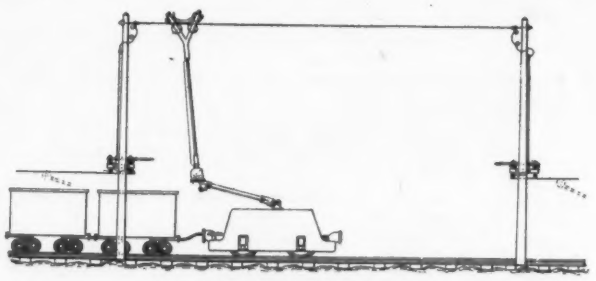
751,886. APPARATUS FOR STERILIZING WATER; Henry Jacques Wessels, Paris, France. App. filed June 22, 1903. (See page 361.)

751,900. TROLLEY ROAD CROSSING; James M. Collins, Byersville, O. App. filed Feb. 2, 1901. At the crossing the trolley wire is raised to an elevation where it will not interfere with crossing traffic and to enable cars to connect with the elevated portion at the crossing, an extension trolley is suspended therefrom and engages with the car trolley while the car moves over the crossing.

751,903. SYSTEM FOR THE OPERATION OF ELECTRIC MOTORS; Arthur C. Eastwood, Cleveland, O. App. filed Sept. 25, 1903. Relates to the construction of the controller for operating the reverse switches and closing the circuit through certain solenoids to cut out the sectional resistance.

751,949. ROAD CROSSING DEVICE; Frank L. Sessions, Columbus, O. App. filed Aug. 8, 1902. A modification of 751,900.

751,974. RAIL CONTACT SHOE AND SUPPORT THEREFOR; George W. Brady and Lawrence R. Jones, Wheaton, Ill. App. filed April 13, 1903. The lips of a straddling shoe which bear against the opposite sides of a third-rail and are hinged and spring-supported, to yield on passing around curves.



751,900.—Trolley Road Crossing.

751,982. SOUND MAGNIFIER FOR RELAYS; Matt A. Hacker, Irvine, Ky. App. filed April 28, 1902. The stroke of the armature is delivered to a diaphragm located at the small end of a megaphone.

751,985. UNDERGROUND CONDUIT INSULATION; John M. Humiston, Berwin, Ill. App. filed April 27, 1903. To diminish electrolysis, sections of non-conducting tubing are inserted at intervals in the metallic tubing.

751,986. APPARATUS FOR PURIFYING LIQUIDS; Otto Kartzmark, Brooklyn, N. Y. App. filed Dec. 26, 1900. (See page 361.)

751,991. CURRENT DIRECTOR; James F. McElroy, Albany, N. Y. App. filed Jan. 28, 1901. A switch having contact fingers in two sets, one used for making and breaking circuit while the other is used for distributing current in two or more circuits.

752,005. ELECTRIC ARC LAMP; Frederick Sindingchristensen, Brooklyn, N. Y. App. filed Aug. 29, 1902. Details of the feed mechanism.

752,008. INDUCTION COIL; Charles F. Splitdorf, New York, N. Y. App. filed July 15, 1902. A thin sheet of hard rubber is wrapped several times around the outside of the primary winding.

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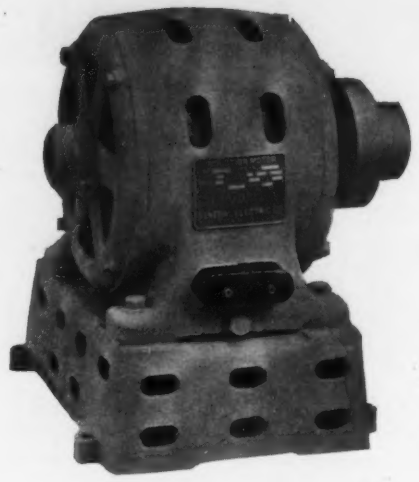

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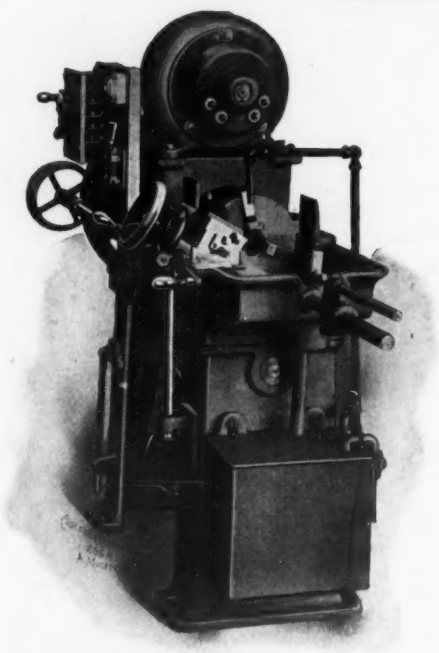

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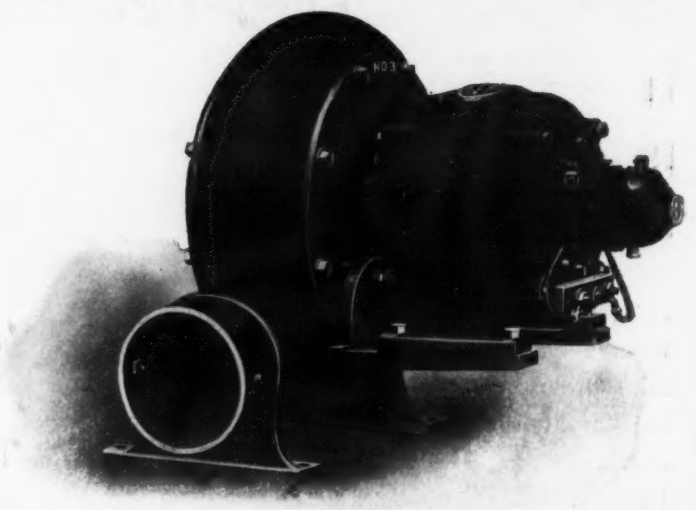

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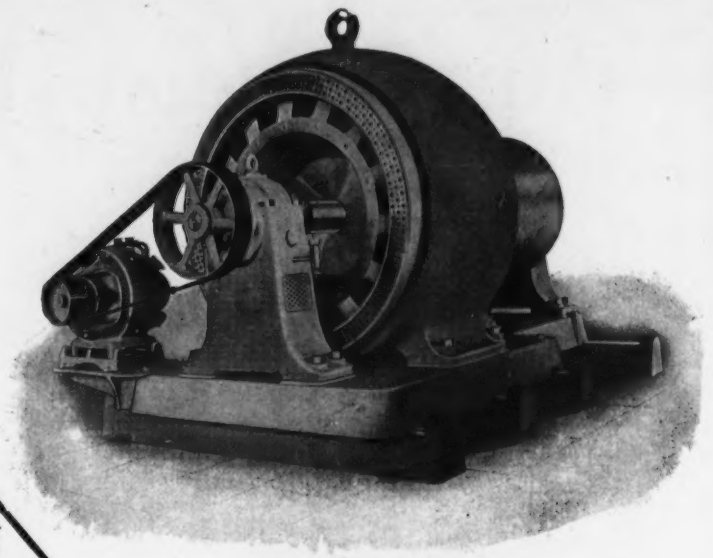

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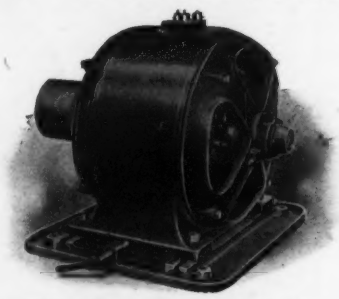

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